



NTNU – Trondheim
Norwegian University of
Science and Technology

Purchasing in engineer-to-order companies

The use of purchasing tools in Norwegian
engineer-to-order companies

Mads Veilemand Holstad
Børge Sjøbakk
Fredrik Dehnæs Stokke

Industrial Economics and Technology Management

Submission date: June 2012

Supervisor: Luitzen de Boer, IØT

Co-supervisor: Elsebeth Holmen, IØT
Bjørn Ragnar Albrigtsen, SINTEF

Norwegian University of Science and Technology
Department of Industrial Economics and Technology Management

SAMARBEIDSKONTRAKT

1. Studenter i samarbeidsgruppen

Etternavn, fornavn Holstad, Mads Veilemand	Fødselsdato 06. aug 1987
Etternavn, fornavn Sjøbakk, Børge	Fødselsdato 05. mar 1987
Etternavn, fornavn Stokke, Fredrik Dehnæs	Fødselsdato 19. mai 1987

2. Hovedveileder

Etternavn, fornavn de Boer, Luitzen	Institutt Institutt for industriell økonomi og teknologiledelse
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3. Masteroppgave

Oppgavens (foreløpige) tittel Purchasing in engineer-to-order companies The use of purchasing tools in Norwegian engineer-to-order companies
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4. Bedømmelse

Kandidatene skal ha *individuell* bedømmelse
Kandidatene skal ha *felles* bedømmelse

<input type="checkbox"/>
<input checked="" type="checkbox"/>

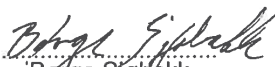
TRONDHEIM - 16.01.2012

.....
Sted og dato


.....
Hovedveileder

MADS HOLSTAD

.....
Mads Veilemand Holstad


.....
Børge Sjøbakk

Fredrik D. Stokke

.....
Fredrik Dehnæs Stokke

Originalen oppbevares på instituttet.

MASTERKONTRAKT

- uttak av masteroppgave

1. Studentens personalia

Etternavn, fornavn Sjøbakk, Børge	Fødselsdato 05. mar 1987
E-post borgesj@stud.ntnu.no	Telefon 98073913

2. Studieopplysninger

Fakultet Fakultet for Samfunnsvitenskap og teknologiledelse	
Institutt Institutt for industriell økonomi og teknologiledelse	
Studieprogram Industriell økonomi og teknologiledelse	Hovedprofil Strategisk innkjøps- og forsyningsledelse

3. Masteroppgave

Oppstartsdato 16. jan 2012	Innleveringsfrist 11. jun 2012
Oppgavens (foreløpige) tittel Purchasing in engineer-to-order companies The use of purchasing tools in Norwegian engineer-to-order companies	
Oppgavetekst/Problembeskrivelse The purpose of this master thesis is to study the use of purchasing tools, especially purchasing portfolio approaches, in Norwegian engineer-to-order (ETO) companies. There will also be a focus on ETO characteristics, and their influence on purchasing in ETO companies. The study will comprise the following main parts: <ol style="list-style-type: none">1. A review of theories on purchasing tools and purchasing sophistication2. Empirical investigation of ETO characteristics and ETO companies' use of purchasing tools3. An analysis and discussion of findings4. Conclusions and implications	
Hovedveileder ved institutt Professor Luitzen de Boer	Medveileder(e) ved institutt Elsebeth Holmen
Ekstern bedrift/institusjon SINTEF	Ekstern veileder ved bedrift/institusjon Bjørn Ragnar Albrigtsen
Merknader 1 uke ekstra p.g.a påske.	

4. Underskrift

Student: Jeg erklærer herved at jeg har satt meg inn i gjeldende bestemmelser for mastergradsstudiet og at jeg oppfyller kravene for adgang til å påbegynne oppgaven, herunder eventuelle praksiskrav.

Partene er gjort kjent med avtalens vilkår, samt kapitlene i studiehandboken om generelle regler og aktuell studieplan for masterstudiet.

TRONDHEIM - 16.01.2012
.....
Sted og dato


.....
Student


.....
Hovedveileder

MASTERKONTRAKT

- uttak av masteroppgave

1. Studentens personalia

Etternavn, fornavn Holstad, Mads Veilemand	Fødselsdato 06. aug 1987
E-post holstad@stud.ntnu.no	Telefon 48263010

2. Studieopplysninger

Fakultet Fakultet for Samfunnsvitenskap og teknologiledelse	
Institutt Institutt for industriell økonomi og teknologiledelse	
Studieprogram Industriell økonomi og teknologiledelse	Hovedprofil Strategisk innkjøps- og forsyningsledelse

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TRONDHEIM - 16.01.2012

.....
Sted og dato

MADS HOLSTAD.....
Student


.....
Hovedveileder

MASTERKONTRAKT

- uttak av masteroppgave

1. Studentens personalia

Etternavn, fornavn Stokke, Fredrik Dehnæs	Fødselsdato 19. mai 1987
E-post fredrsto@stud.ntnu.no	Telefon 41511094

2. Studieopplysninger

Fakultet Fakultet for Samfunnsvitenskap og teknologiledelse	
Institutt Institutt for industriell økonomi og teknologiledelse	
Studieprogram Industriell økonomi og teknologiledelse	Hovedprofil Strategisk innkjøps- og forsyningsledelse

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TRONDHEIM - 16.01.2012

.....
Sted og dato

Frederik Stokke
.....
Student


.....
Hovedveileder

Originalen lagres i NTNUs elektroniske arkiv. Kopi av avtalen sendes til instituttet og studenten.

Fastsatt av Rektor 20.01.2012

STANDARDAVTALE

om utføring av masteroppgave/prosjektoppgave (oppgave) i samarbeid med bedrift/ekstern virksomhet (bedrift).

Avtalen er ufravikelig for studentoppgaver ved NTNU som utføres i samarbeid med bedrift.

Partene har ansvar for å klarere eventuelle immaterielle rettigheter som tredjeperson (som ikke er part i avtalen) kan ha til prosjektbakgrunn før bruk i forbindelse med utførelse av oppgaven.

Avtale mellom

Student: <u>BØRGE SJØBÅKK</u>	født: <u>05.03.87</u>
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Veileder ved NTNU: <u>LUITZEN DE BOER</u>

Bedrift/ekstern virksomhet: <u>FUGRO OCEANOR</u>
--

og

Norges teknisk-naturvitenskapelige universitet (NTNU) v/instituttleder
--

om bruk og utnyttelse av resultater fra masteroppgave/prosjektoppgave.

1. Utførelse av oppgave

Studenten skal utføre

Masteroppgave	<input checked="" type="checkbox"/>
Prosjektoppgave	<input type="checkbox"/>

(sett kryss)

i samarbeid med

<u>FUGRO OCEANOR</u>

bedrift/ekstern virksomhet

FV

15.01.2012 - 11.06.2012

startdato – sluttdato

Oppgavens tittel er:

PURCHASING IN ENGINEER-TO-ORDER COMPANIES

Ansvarlig veileder ved NTNU har det overordnede faglige ansvaret for utforming og godkjenning av prosjektbeskrivelse og studentens læring.

2. Bedriftens plikter

Bedriften skal stille med en kontaktperson som har nødvendig veiledningskompetanse og gi studenten tilstrekkelig veiledning i samarbeid med veileder ved NTNU. Bedriftens kontaktperson er:

FREDRIK DESSEN

Formålet med oppgaven er studentarbeid. Oppgaven utføres som ledd i studiet, og studenten skal ikke motta lønn eller lignende godtgjørelse fra bedriften. Bedriften skal dekke følgende utgifter knyttet til utførelse av oppgaven:

INGEN.

3. Partenes rettigheter

a) Studenten

Studenten har opphavsrett til oppgaven. Alle immaterielle rettigheter til resultater av oppgaven skapt av studenten alene gjennom oppgavearbeidet, eies av studenten med de reserverasjoner som følger av punktene b) og c) nedenfor.

Studenten har rett til å inngå egen avtale med NTNU om publisering av sin oppgave i NTNUs institusjonelle arkiv på internett. Studenten har også rett til å publisere oppgaven eller deler av den i andre sammenhenger dersom det ikke i denne avtalen er avtalt begrensninger i adgangen til å publisere, jf punkt 4.

b) Bedriften

Der oppgaven bygger på, eller videreutvikler materiale og/eller metoder (prosjektbakgrunn) som eies av bedriften, eies prosjektbakgrunnen fortsatt av bedriften. Eventuell utnyttelse av videreutviklingen, som inkluderer prosjektbakgrunnen, forutsetter at det inngås egen avtale om dette mellom student og bedrift.

Bedriften skal ha rett til å benytte resultatene av oppgaven i egen virksomhet dersom utnyttelsen faller innenfor bedriftens virksomhetsområde. Dette skal fortolkes i samsvar med begrepets innhold i Arbeidstakeroppfinningsloven¹ § 4. Retten er ikke-eksklusiv.

Bruk av resultatet av oppgaven utenfor bedriften sitt virksomhetsområde, jf avsnittet ovenfor, forutsetter at det inngås egen avtale mellom studenten og bedriften. Avtale mellom bedrift og student om rettigheter til oppgaveresultater som er skapt av studenten, skal inngås skriftlig og er ikke gyldig inngått før NTNU har mottatt skriftlig gjenpart av avtalen.

Dersom verdien av bruken av resultatene av oppgaven er betydelig, dvs overstiger NOK 100.000 (kommentert i veiledningen² til avtalen), er studenten berettiget til et rimelig vederlag. Arbeidstakeroppfinningsloven § 7 gis anvendelse på vederlagsberegningen. Denne vederlagsretten gjelder også for ikke-patenterbare resultater. Fristbestemmelsene i § 7 gis tilsvarende anvendelse.

c) NTNU

De innleverte eksemplarer/filer av oppgaven med vedlegg, som er nødvendig for sensur og arkivering ved NTNU, tilhører NTNU. NTNU får en vederlagsfri bruksrett til resultatene av oppgaven, inkludert vedlegg til denne, og kan benytte dette til undervisnings- og forskningsformål med de eventuelle begrensninger som fremgår i punkt 4.

4. Utsatt offentliggjøring

Hovedregelen er at studentoppgaver skal være offentlige. I særlige tilfeller kan partene bli enig om at hele eller deler av oppgaven skal være undergitt utsatt offentliggjøring i maksimalt 3 år, dvs. ikke tilgjengelig for andre enn student og bedrift i denne perioden.

Oppgaven skal være undergitt utsatt offentliggjøring i

ett år	
to år	
tre år	X

(sett kryss bak antall år hvis dette punktet er aktuelt)

Behovet for utsatt offentliggjøring er begrunnet ut fra følgende:

KONKURRANSEHENSYN GJØR AT OPPGAVEN UTSETTES FOR
OFFENTLIGGJØRING I 3 ÅR.

De delene av oppgaven som ikke er undergitt utsatt offentliggjøring, kan publiseres i NTNUs institusjonelle arkiv, jf punkt 3 a), andre avsnitt.

¹ Lov av 17. april 1970 om retten til oppfinnelser som er gjort av arbeidstakere
<http://www.lovdata.no/all/hl-19700417-021.html>

² Veiledning til NTNUs standardavtale om masteroppgave/prosjektoppgave i samarbeid med bedrift
<http://www.ntnu.no/studier/standardavtaler>

Selv om oppgaven er undergitt utsatt offentliggjøring, skal bedriften legge til rette for at studenten kan benytte hele eller deler av oppgaven i forbindelse med jobbsøknader samt videreføring i et doktorgradsarbeid.

5. Generelt

Denne avtalen skal ha gyldighet foran andre avtaler som er eller blir opprettet mellom to av partene som er nevnt ovenfor. Dersom student og bedrift skal inngå avtale om konfidensialitet om det som studenten får kjennskap til i bedriften, skal NTNUs standardmal for konfidensialitetsavtale benyttes. Eventuell avtale om dette skal vedlegges denne avtalen.

Eventuell uenighet som følge av denne avtalen skal søkes løst ved forhandlinger. Hvis dette ikke fører frem, er partene enige om at tvisten avgjøres ved voldgift i henhold til norsk lov. Tvisten avgjøres av sorenskriveren ved Sør-Trøndelag tingrett eller den han/hun oppnevner.

Denne avtale er underskrevet i 4 - fire - eksemplarer hvor partene skal ha hvert sitt eksemplar. Avtalen er gyldig når den er godkjent og underskrevet av NTNU v/instituttleder.

07/06/12
sted, dato


Perge Sjøvoll
student

sted, dato

[Signature]
veileder ved NTNU

T.M. 7/8/12
sted, dato

[Signature]
instituttleder, NTNU

 **NTNU**
Institutt for industriell økonomi
og teknologiledelse
7491 TRONDHEIM
institutt

8/5-12
sted, dato

[Signature]
for bedriften/institusjonen
stempel og signatur

 **Fugro OCEANOR AS**
Tel: +47 73 54 52 00 Fax: +47 73 54 52 01
P.O. Sentrertel N-7462 Trondheim, Norway

Fastsatt av Rektor 20.01.2012

STANDARDAVTALE

om utføring av masteroppgave/prosjektoppgave (oppgave) i samarbeid med bedrift/ekstern virksomhet (bedrift).

Avtalen er ufravikelig for studentoppgaver ved NTNU som utføres i samarbeid med bedrift.

Partene har ansvar for å klarere eventuelle immaterielle rettigheter som tredjeperson (som ikke er part i avtalen) kan ha til prosjektbakgrunn før bruk i forbindelse med utførelse av oppgaven.

Avtale mellom

Student: MADS HASTAD	født: 06.08.87
----------------------	----------------

Veileder ved NTNU: LUITZEN DE BOER

Bedrift/ekstern virksomhet: FUGRO OCEANOR

og

Norges teknisk-naturvitenskapelige universitet (NTNU) v/instituttleder
--

om bruk og utnyttelse av resultater fra masteroppgave/prosjektoppgave.

1. Utførelse av oppgave

Studenten skal utføre

Masteroppgave	X
Prosjektoppgave	

(sett kryss)

i samarbeid med

FUGRO OCEANOR

bedrift/ekstern virksomhet

RD

15.01.2012 - 11.06.2012

startdato – sluttdato

Oppgavens tittel er:

PURCHASING IN ENGINEER-TO-ORDER COMPANIES

Ansvarlig veileder ved NTNU har det overordnede faglige ansvaret for utforming og godkjenning av prosjektbeskrivelse og studentens læring.

2. Bedriftens plikter

Bedriften skal stille med en kontaktperson som har nødvendig veiledningskompetanse og gi studenten tilstrekkelig veiledning i samarbeid med veileder ved NTNU. Bedriftens kontaktperson er:

FREDRIK DESSEN

Formålet med oppgaven er studentarbeid. Oppgaven utføres som ledd i studiet, og studenten skal ikke motta lønn eller lignende godtgjørelse fra bedriften. Bedriften skal dekke følgende utgifter knyttet til utførelse av oppgaven:

INGEN.

3. Partenes rettigheter

a) Studenten

Studenten har opphavsrett til oppgaven. Alle immaterielle rettigheter til resultater av oppgaven skapt av studenten alene gjennom oppgavearbeidet, eies av studenten med de reserverasjoner som følger av punktene b) og c) nedenfor.

Studenten har rett til å inngå egen avtale med NTNU om publisering av sin oppgave i NTNUs institusjonelle arkiv på internett. Studenten har også rett til å publisere oppgaven eller deler av den i andre sammenhenger dersom det ikke i denne avtalen er avtalt begrensninger i adgangen til å publisere, jf punkt 4.

b) Bedriften

Der oppgaven bygger på, eller videreutvikler materiale og/eller metoder (prosjektbakgrunn) som eies av bedriften, eies prosjektbakgrunnen fortsatt av bedriften. Eventuell utnyttelse av videreutviklingen, som inkluderer prosjektbakgrunnen, forutsetter at det inngås egen avtale om dette mellom student og bedrift.

Bedriften skal ha rett til å benytte resultatene av oppgaven i egen virksomhet dersom utnyttelsen faller innenfor bedriftens virksomhetsområde. Dette skal fortolkes i samsvar med begrepetts innhold i Arbeidstakeroppfinnelsesloven¹ § 4. Retten er ikke-eksklusiv.

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Dersom verdien av bruken av resultatene av oppgaven er betydelig, dvs overstiger NOK 100.000 (kommentert i veiledningen² til avtalen), er studenten berettiget til et rimelig vederlag. Arbeidstakeroppfinnelsesloven § 7 gis anvendelse på vederlagsberegningen. Denne vederlagsretten gjelder også for ikke-patenterbare resultater. Fristbestemmelsene i § 7 gis tilsvarende anvendelse.

c) NTNU

De innleverte eksemplarer/filer av oppgaven med vedlegg, som er nødvendig for sensur og arkivering ved NTNU, tilhører NTNU. NTNU får en vederlagsfri bruksrett til resultatene av oppgaven, inkludert vedlegg til denne, og kan benytte dette til undervisnings- og forskningsformål med de eventuelle begrensninger som fremgår i punkt 4.

4. Utsatt offentliggjøring

Hovedregelen er at studentoppgaver skal være offentlige. I særlige tilfeller kan partene bli enig om at hele eller deler av oppgaven skal være undergitt utsatt offentliggjøring i maksimalt 3 år, dvs. ikke tilgjengelig for andre enn student og bedrift i denne perioden.

Opgaven skal være undergitt utsatt offentliggjøring i

ett år	
to år	
tre år	X

(sett kryss bak antall år hvis dette punktet er aktuelt)

Behovet for utsatt offentliggjøring er begrunnet ut fra følgende:

KONKURRANSEHENSYN GJØR AT OPPGAVEN UTSETTES FOR
OFFENTLIGGJØRING I 3 ÅR.

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5. Generelt

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Eventuell uenighet som følge av denne avtalen skal søkes løst ved forhandlinger. Hvis dette ikke fører frem, er partene enige om at tvisten avgjøres ved voldgift i henhold til norsk lov. Tvisten avgjøres av sorenskriveren ved Sør-Trøndelag tingrett eller den han/hun oppnevner.

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TRONDHEIM

07-06-2012

sted, dato

MADS HOLSTAD

student

sted, dato

veileder ved NTNU

Tubha 7/6-12

sted, dato

instituttleder, NTNU

NTNU

Institutt for industriell økonomi
og teknologiledelse
7491 TRONDHEIM

5/5-12

sted, dato

for bedriften/institusjonen
stempel og signatur



Fastsatt av Rektor 20.01.2012

STANDARDAVTALE

om utføring av masteroppgave/prosjektoppgave (oppgave) i samarbeid med bedrift/ekstern virksomhet (bedrift).

Avtalen er ufravikelig for studentoppgaver ved NTNU som utføres i samarbeid med bedrift.

Partene har ansvar for å klarere eventuelle immaterielle rettigheter som tredjeperson (som ikke er part i avtalen) kan ha til prosjektbakgrunn før bruk i forbindelse med utførelse av oppgaven.

Avtale mellom

Student: FREDRIK STØKKE	født: 19.05.1987
-------------------------	------------------

Veileder ved NTNU: LUITZEN DE BOER

Bedrift/ekstern virksomhet: FUGRO OCEANOR

og

Norges teknisk-naturvitenskapelige universitet (NTNU) v/instituttleder
--

om bruk og utnyttelse av resultater fra masteroppgave/prosjektoppgave.

1. Utførelse av oppgave

Studenten skal utføre

Masteroppgave	<input checked="" type="checkbox"/>
Prosjektoppgave	<input type="checkbox"/>

(sett kryss)

i samarbeid med

FUGRO OCEANOR

bedrift/ekstern virksomhet



15.01.2012 - 11.06.2012

startdato – sluttdato

Oppgavens tittel er:

PURCHASING IN ENGINEER-TO-ORDER COMPANIES

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INGEN.

3. Partenes rettigheter

a) Studenten

Studenten har opphavsrett til oppgaven. Alle immaterielle rettigheter til resultater av oppgaven skapt av studenten alene gjennom oppgavearbeidet, eies av studenten med de reservasjoner som følger av punktene b) og c) nedenfor.

Studenten har rett til å inngå egen avtale med NTNU om publisering av sin oppgave i NTNUs institusjonelle arkiv på internett. Studenten har også rett til å publisere oppgaven eller deler av den i andre sammenhenger dersom det ikke i denne avtalen er avtalt begrensninger i adgangen til å publisere, jf punkt 4.

b) Bedriften

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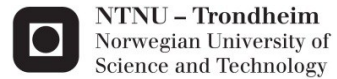
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Master's thesis – spring 2012



Purchasing in engineer-to-order companies

The use of purchasing tools in Norwegian engineer-to-order companies

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Trondheim, June 2012

Preface

This master's thesis is written within the Strategic Purchasing and Supply Management profile at the Department of Industrial Economics and Technology Management, NTNU. The thesis is also a contribution to the research project MARGIN, spring 2012.

The title of the master's thesis is "Purchasing in engineer-to-order companies – The use of purchasing tools in Norwegian engineer-to-order companies". Following in the lines of the MARGIN project and an identified theoretical gap with respect to the engineer-to-order (ETO) production situation, the purpose of this master's thesis is to study the use of purchasing tools, especially purchasing portfolio approaches, in Norwegian ETO companies. The master's thesis is a continuation of a specialization project written by the authors in fall 2011.

We wish to thank our supervisors at the Department of Industrial Economics and Technology Management, Professor Luitzen De Boer and Associate Professor Elsebeth Holmen, and Bjørn Albrigtsen at SINTEF, for their priceless guidance during the research process. We also thank Professor Arjan van Weele and Associate Professor Cees Gelderman for sharing questions from a questionnaire they distributed in the Netherlands, in order to achieve replication and comparisons with Norwegian practice.

Further, we wish to give thanks to Fugro OCEANOR for invaluable empirical data and co-operation. We also wish to thank Lena Frøyland Larsson and Line Marlene Helberg Young at NIMA, Ottar Bakås and Torbjørn Akersveen at NCEI, Kjell O. Johannessen at NCE NODE and Antonia Guiogova at NCE Maritime for being of help in distributing our questionnaire. Finally, we thank all the companies that have participated in the making of this master's thesis through answering our questionnaire.

Trondheim, 11th of June 2012

Mads V. Holstad

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Summary

This master's thesis is written as a contribution to the MARGIN project, which is a three-year research project conducted by Kongsberg Maritime, Noca, Roxar and Fugro OCEANOR (Fugro), in collaboration with SINTEF, HiST and the NCEI cluster. Further, the master's thesis is a continuation of a specialization project written by the authors in fall 2011. In the specialization project, Fugro was chosen as a collaborating partner. This collaboration is continued in this master's thesis.

Following in the lines of the MARGIN project and an identified theoretical gap with respect to the engineer-to-order (ETO) production situation, we set out to explore how the level of purchasing sophistication affects the use of purchasing portfolio approaches in Norwegian ETO companies. To answer this problem, we have conducted three literature reviews and mixed methods research; the latter comprising qualitative action research and quantitative survey research. Literature reviews on purchasing portfolio approaches and ETO were conducted in fall 2011 and are further refined in this master's thesis. The specialization project brought forth a need for further research with respect to purchasing sophistication. As such, a literature review on purchasing sophistication was conducted at the departure of this master's thesis. Findings from the literature reviews were brought together in a theoretical framework. Following the empirical investigation, this framework was further refined with gained knowledge from both survey- and action research. This refined framework was thereafter utilized in analyzing the connections between the three main topics of purchasing portfolio approaches, purchasing sophistication and ETO.

Survey research established two statistically significant connections between purchasing portfolio approaches and purchasing sophistication. First, the use of purchasing portfolio approaches was found to have a significant relationship with having a sourcing strategy. The latter variable further displayed a statistically significant higher level of purchasing sophistication for companies in possession of a sourcing strategy. Second, the use of purchasing portfolio approaches indicated a statistically significant relationship with the skills of the purchasing professionals; the latter identified as a dimension of purchasing sophistication. Based on these findings, we argued that the use of purchasing portfolio approaches may lead to a higher level of purchasing sophistication – both by establishing sourcing strategies and facilitating the development of the skills pertaining to the purchasing professionals. Thereafter, action research findings enabled us to develop a segmentation model, differentiating between prevalent purchasing portfolio approaches based on relevant characteristics of purchasing sophistication. Hence, we developed a tool for choosing an appropriate purchasing portfolio approach, given the company's level of purchasing sophistication.

In investigating the relationship between purchasing sophistication and the ETO production situation, we employed both survey and action research in order to evaluate ETO companies' level of purchasing sophistication. This evaluation was further utilized in respect to the connection between purchasing portfolio approaches and ETO. Here, survey and action research findings revealed several benefits for an ETO company to use a purchasing portfolio approach. As such, we utilized the previously developed segmentation model, and

recommended a purchasing portfolio approach by taking into account the preceding evaluation of purchasing sophistication of ETO companies. This led us to suggest that an ETO company, with similar characteristics as Fugro, should adopt the purchasing portfolio approach by van Weele (2010). In addition, the action research findings enabled us to modify the suggested approach, in order to take into consideration the identified power and dependence characteristics found prevalent for ETO companies with similar characteristics as Fugro. These action research findings also enabled us to provide guidelines for the use of such an approach.

In conclusion, we have established a relationship between purchasing portfolio approaches, purchasing sophistication and ETO. As such, we have, in an elaborate manner succeeded in answering the purpose of this master's thesis.

Norwegian summary

Denne masteroppgaven er et bidrag til MARGIN, som er et treårig forskningsprosjekt gjennomført av Kongsberg Maritime, Noca, Roxar og Fugro OCEANOR (Fugro), i samarbeid med SINTEF, HiST og NCEI-klyngen. Masteroppgaven er også en fortsettelse av et fordypningsprosjekt skrevet av forfatterne høsten 2011. I fordypningsprosjektet ble Fugro valgt som samarbeidspartner. Dette samarbeidet er videreført i denne masteroppgaven.

I tråd med MARGIN-prosjektets retningslinjer og et identifisert teoretisk gap med hensyn til produksjonssituasjonen *engineer-to-order* (ETO), ønsket vi å undersøke hvordan innkjøpsfunksjonens nivå av sofistikering (*level of purchasing sophistication*) påvirker bruken av porteføljetilnærminger for innkjøp (*purchasing portfolio approaches*) i norske ETO-bedrifter. For å svare på dette forskningsproblemet, har vi gjennomført tre litteraturstudier og benyttet oss av blandede forskningsmetoder (*mixed methods research*). I forhold til de blandede forskningsmetodene, har vi gjennomført kvalitativ aksjonsforskning (*action research*) og kvantitativ spørreundersøkelse (*survey research*). Litteraturstudiene om porteføljetilnærminger for innkjøp og ETO ble gjennomført i løpet av høsten 2011, og er videreutviklet i denne masteroppgaven. Fordypningsprosjektet motiverte et behov for videre forskning men hensyn til innkjøpsfunksjonens nivå av sofistikering. Et litteraturstudie om innkjøpsfunksjonens nivå av sofistikering er derfor gjennomført i denne masteroppgaven. Funn fra litteraturstudiene ble brukt til å lage et teoretisk rammeverk. Etter innhenting av empiriske data, ble dette rammeverket videreutviklet med kunnskap tilegnet gjennom både spørreundersøkelse og aksjonsforskning. Dette videreutviklede rammeverket ble deretter brukt for å analysere sammenhengene mellom emnene porteføljetilnærminger for innkjøp, innkjøpsfunksjonens nivå av sofistikering og ETO.

Spørreundersøkelsen avdekket to statistisk signifikante sammenhenger mellom porteføljetilnærminger for innkjøp og innkjøpsfunksjonens nivå av sofistikering. For det første, ble bruken av porteføljetilnærminger for innkjøp funnet å ha et signifikant forhold til det å ha en innkjøpsstrategi (*sourcing strategy*). Det å ha en innkjøpsstrategi viste seg videre å være relatert til et signifikant høyere nivå av innkjøpsfunksjonens sofistikering. For det andre, viste bruken av porteføljetilnærminger for innkjøp å indikere et statistisk signifikant forhold til ferdighetene til innkjøperne (*skills of the purchasing professionals*), hvor sistnevnte er identifisert som en dimensjon av innkjøpsfunksjonens nivå av sofistikering. Basert på disse funnene, argumenterte vi for at bruken av porteføljetilnærminger for innkjøp kan føre til et høyere nivå av sofistikering i innkjøpsfunksjonen – både ved å etablere innkjøpsstrategier og fasilitere utvikling av ferdighetene til innkjøperne. Deretter gjorde funn fra aksjonsforskningen at vi kunne utvikle en segmenteringsmodell, som skiller mellom de mest kjente porteføljetilnærmingene for innkjøp basert på relevante karakteristika av innkjøpsfunksjonens nivå av sofistikering. Slik utviklet vi et verktøy for å velge en egnet porteføljetilnærming for innkjøp, gitt et selskaps nivå av sofistikering i innkjøpsfunksjonen.

Når vi undersøkte sammenhengen mellom innkjøpsfunksjonens nivå av sofistikering og produksjonssituasjonen ETO, brukte vi funn både fra spørreundersøkelsen og aksjonsforskningen for å evaluere nivå av sofistikering i et ETO-selskaps innkjøpsfunksjon.

Denne evalueringen ble videre benyttet da vi undersøkte sammenhengen mellom porteføljetilnæringer for innkjøp og produksjonssituasjonen ETO. Her avdekket spørreundersøkelsen og aksjonsforskningen flere fordeler ved å bruke porteføljetilnæringer for innkjøp, for et ETO-selskap. Som følge av dette, så brukte vi den tidligere utviklede segmenteringsmodellen, og anbefalte en porteføljetilnærming for innkjøp ved å inkorporere et hensyn til innkjøpsfunksjonens nivå av sofistikering i ETO-selskaper. Dette gjorde at vi foreslo at et ETO-selskap, men liknende karakteristikk som Fugro, bør bruke porteføljetilnærmingen for innkjøp av van Weele (2010). I tillegg muliggjorde funn fra aksjonsforskningen at vi kunne modifisere denne tilnærmingen, for å ta hensyn til identifisere maktforhold for ETO-selskaper med liknende karakteristikk som Fugro. Disse funnene fra aksjonsforskningen gjorde også at vi kunne etablere retningslinjer for bruk av denne porteføljetilnærmingen for innkjøp.

Oppsummert har vi etablert et forhold mellom porteføljetilnæringer for innkjøp, innkjøpsfunksjonens nivå av sofistikering og ETO. På denne måten har vi på en omstendelig og ryddig måte oppnådd hensikten ved denne masteroppgaven.

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1 Introduction

This introduction serves two main purposes. First, the background for this master's thesis will be presented, to provide the reader with necessary contextual information. Second, the problem to be analyzed, motivated by elements elucidated in the background, is described. After a succeeding chapter on methodology, the document comprises four main parts: Theoretical foundation; Empirical investigation; Analysis and discussion; and, Conclusions and implications. We refer to the table of contents for a more detailed overview of the document structure.

1.1 Background

This section provides the reader with the necessary contextual information for this master's thesis. First, information about the authors is provided, as we believe that our theoretical background has shaped the scope of this master's thesis. Thereafter a description of the MARGIN research project is given, as a means to provide the reader with insight in how this master's thesis contributes to the research project. A brief discussion on the concepts of *customization*, the closely related *engineer-to-order* production situation and the evolution of purchasing's importance, elucidated by literature on the subjects, will provide the reader with insight necessary to follow the subsequent discussions. This is followed by a description of the roles and responsibilities of the purchasing function. Finally, a summary of the specialization project written by the authors in fall 2011 is provided, as it constituted our point of departure for writing this master's thesis.

1.1.1 About the authors

This master's thesis is written by Mads Veilemand Holstad, Børge Sjøbakk and Fredrik Dehnæs Stokke. The authors are students at the Department of Industrial Economics and Technology Management (IØT) at the Norwegian University of Science and Technology (NTNU). The IØT study programme consists of 40 % technological courses, 20 % methodology courses (e.g. mathematics, statistics and physics), and approximately 40 % economical/administrative courses, providing students with an interdisciplinary theoretical background (NTNU, 2012). All three authors attend the Strategic Purchasing and Supply Management specialization course, constituting the economical/administrative part of the study, whereas the authors' technical background is from the Department of Production and Quality Engineering (IPK).

Courses under the auspices of IPK have provided us with insight into production and supply chain management, with a special focus on operational and tactical challenges. Further, the Strategic Purchasing and Supply Management specialization course has given us insight in purchasing and supply management at a strategic level. With the goal of utilizing our theoretical background, we have chosen to write about strategic purchasing tools in production companies; more specifically engineer-to-order (ETO) companies. As such, we draw on knowledge acquired both in technical courses and more administrative/economical courses, which has definitely influenced the scope of this master's thesis. In the next subsection, the MARGIN research project is introduced. As will be shown, our theoretical background has dictated which research area within MARGIN this master's thesis is a contribution to.

1.1.2 The MARGIN research project

Norway, and especially Mid-Norway, has a strong and important tradition as an industrial actor (MARGIN, 2011a). Small and medium-sized Mid-Norwegian suppliers, particularly in the technology sector, have in the recent years increased their focus on export towards global markets (NHO Trøndelag, 2011). Particularly, actors in the maritime industry are experiencing a shift in their main markets to the East (Maritim21, 2010). Intensification of the global competition puts Mid-Norwegian suppliers to the test. To secure their competitiveness, solutions for efficient production processes in more integrated and responsive supply chains must be developed (MARGIN, 2011b). This forms the basis for the research project MARGIN.

MARGIN is a three-year research project conducted by Kongsberg Maritime, Noca, Roxar and Fugro OCEANOR, in collaboration with SINTEF, Sør-Trøndelag University College (HiST) and the NCEI (Norwegian Centre of Expertise Instrumentation) cluster. The project's aim is to develop integrated and responsive supply chains among actors in the Mid-Norwegian maritime supplier industry. There are four main research areas in the project: (1) Supplier collaboration and management; (2) efficient and responsive production; (3) new business models for the after-sales market; and (4) ICT integration in the entire supply chain. (MARGIN, 2011b; c)

The four research areas are illustrated in the conceptual model for the MARGIN project (Figure 1). As can be seen from the figure, the profit margin contribution from the production stage is relatively low; firms experience that the value added is becoming increasingly concentrated at the upstream and downstream ends of the value chain (Mudambi, 2008). The rationale underlying MARGIN is that the member companies, and in the longer run the industry, can increase their margins by focusing on the stages upstream and downstream. Consequently, they could develop through increased integration with suppliers; increased contribution from existing operations; development of new business models for the after-sales market; and, total integration of logistics and technical information throughout the supply chain (MARGIN, 2011c). These developments demand new know-how, concepts and solutions, as the characteristics of the Mid-Norwegian supplier industry differ from the premises that the bulk of sourcing and supply chain literature is built upon (MARGIN, 2011a).

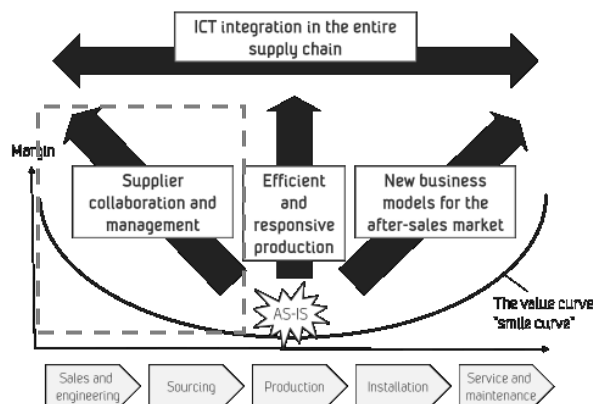


Figure 1: Conceptual model for the MARGIN project (MARGIN, 2011c)

Given the authors' background (1.1.1), the scope of this master's thesis lies at the upstream side of Figure 1; covering the research area "supplier collaboration and management". As such, the master's thesis contributes to one of four research areas in MARGIN, supplementing other master's theses that cover the remaining research areas. In fall 2011, the authors executed a specialization project concerning purchasing portfolio approaches to sourcing strategies in ETO companies, which this master's thesis is a continuation of (this is further described in 1.1.6 and 1.2). In the specialization project Fugro OCEANOR (hereafter: Fugro) was, as a result of a discussion between SINTEF, the course staff and the authors, chosen as a collaborator. This was mainly due to the fact that Fugro could be classified as an ETO company. This collaboration is continued throughout the master's thesis, as ETO still is a topic of research. In order to motivate this, a theory gap with respect to literature on ETO is presented in the next subsection on customization.

1.1.3 Customization

In their 1996 article "Customizing customization", Lampel and Mintzberg conclude, on the basis of a comprehensive literature review, that "a flood of recent publications attest to the widespread belief that we are in the midst of a fundamental technological change in manufacturing, communication, distribution and retailing – a virtual renaissance of customization" (p.28). Fredriksson and Gadde (2005) find that more recent literature reviews show a continuance of the attention to customization. They claim that the increasing interest in customization can partly be explained by the fact that customers demand highly customized products and services, and partly by its marketing drive; it is claimed to improve the competitive position of the company. This is also supported by Gunasekaran and Ngai (2005), who claim that today's market environment is characterized by diverse customer preferences, rapid technological developments and globalization. They argue that these factors have resulted in a need to offer a variety of products, constituting challenges to production managers.

There is a variety of production situations that can be used to meet demand. Some companies anticipate customers' orders based on forecasts and produce to stock, whereas other manufacture in response to customers' orders. Increasingly, firms try to achieve mass customization, that is, the production and distribution of customized goods and services on a mass basis (Alfnes and Strandhagen, 2000). According to Amaro et al. (1999), customized products, whatever the degree of customization, can only be made, or at least finished, to order. An extreme case with respect to degree of customization is the *engineer-to-order* (ETO) production situation, in which highly customized products have to be designed and engineered according to the specifications in the order placed by the customer (Pandit and Zhu, 2007).

Amaro et al. (1999) find that most of the published research in the operations management area has treated all companies the same; as make-to-stock (MTS) companies. Hicks et al. (2000) draw the same conclusion, and find that there is limited research into operations and supply chain management in the ETO sector. In a more recent article, Gosling and Naim (2009) argue that "while the term ETO is used in the literature confusion exists as to the appropriate definitions for this type of operation and the appropriate strategies" (p.741). As these preceding findings show, there seems to be a gap in literature with regard to theory on the ETO production

situation. This is also an assumption underlying the MARGIN project (Margin, 2011a). In order to close some of the ETO theory gap, the focus in this thesis lies on purchasing and its ability to act as a strategic function in ETO companies. As such, a brief summary of purchasing's evolution, becoming a recognized strategic function, is provided in the next subsection.

1.1.4 Purchasing and its strategic relevance

Ellram and Carr (1994) delineate the history behind strategic purchasing and literature on the subject, pointing to episodes in history that have influenced purchasing's strategic importance and the consequential foci in literature. During the early 1970s, purchasing was considered to be an administrative, rather than strategic, function; even though the oil crisis in 1973-74 and shortages in raw materials related to it put the importance of purchasing on the agenda (Ellram and Carr, 1994). Carter and Narasimhan (1996) found that research published as late as 1978 questioned purchasing's contribution to corporate performance. According to Farmer (1997), practice at the time confirmed that the diminished view of purchasing's importance was correct, even though he and others argued that purchasing should develop strategies consistent with corporate strategy (e.g., Farmer, 1978). Top management did, however, not see the need for this; bureaucratic organization structures and the fact that people were recruited to undertake the tasks that fitted the old perception from the late 1960s – that purchasing was a service to production – perpetuated a status quo (Farmer, 1997).

During the 1980s, however, there was a shifting attitude toward purchasing's role in corporate strategies (Ellram and Carr, 1994). In 1983, Kraljic's seminal paper "Purchasing Must Become Supply Management" was published in Harvard Business Review. According to Kraljic (1983), the purchasing function in many companies was characterized by routine; "many purchasing managers' skills and outlooks were formed 20 years ago in an era of relative stability, and they haven't changed" (p.109). He claimed that management must learn to make things happen to its own advantage, instead of monitoring current developments, and argued that "this calls for nothing less than a total change of perspective: from purchasing (an operating function) to supply management (a strategic one)" (Kraljic, 1983, p.110). In line with this, firms throughout the 1980s began to realize the impact the purchasing function can have on their competitive position (Carter and Narasimhan, 1996). Phrases such as 'a 1 per cent saving in purchasing is equal to a 10 per cent increase in sales' were used to uplift its importance (Cousins et al., 2008, p. 8), displaying an economic reason for purchasing's importance.

Ellram and Carr (1994) point out that the focus during the early 1990s was on the means by which the purchasing function can work to become recognized as a more notable contributor to firms' success. This indicates a further strengthening of purchasing as a strategic function, as the question no longer was *whether* purchasing was to be a strategic function, but rather *how* to achieve this. According to Trent and Monczka (1998), there was almost a total reversal of the belief of purchasing as a mere administrative, non-strategic function during the 1990s, as purchasing received attention and respect of executive managers.

In the later years, some researchers have still challenged purchasing's strategic importance. Carter and Narasimhan (1996) ask whether purchasing has an impact on corporate performance,

and if it really is strategic. Through site visits by an ad hoc committee of senior executives, and a thorough questionnaire, they conclude that purchasing indeed is strategic. However, Ramsay (2001) uses the resource based view (RBV) to argue that purchasing is not strategically relevant. He concludes that “it may be stated, with confidence, that purchasing activities are intrinsically operational rather than strategic in nature” (Ramsay, 2001, p.261). Mol (2003) rejects this conclusion in his response to Ramsay’s article, pointing out that there is a wider theoretical base underlying strategic management and developments in the RBV that suggest that purchasing is indeed a strategic activity. In a recent response to the article by Ramsay (2001), Barney (2012) argues that “resource-based theory suggests that purchasing and supply chain management will often have the attributes that can enable them to be sources of sustained competitive advantage” (p.3). Today, in general, it is agreed that purchasing has evolved from a mere clerical buying function into a strategic business function (e.g. Gelderman and van Weele, 2005; Cousins et al., 2008) – it has moved “from the backroom to the boardroom” (van Weele, 2011). In addition to strategic congruence, economics is still a prominent reason for purchasing’s importance (Cousins et al., 2008; Monczka et al., 2011). According to Ellram (1996) purchasing expenditures, as a percentage of an organization’s revenues, average 63 per cent in manufacturing companies. Further, van Weele (2010) finds that the purchasing value in relation to costs of goods sold is approximately 50 per cent. Hence, as the purchasing-to-sales ratio increases, purchasing decisions will have a more profound impact on net results (van Weele, 2010). This is also recognized by Carr and Pearson (1999), as they find that strategic purchasing has a positive impact on firms’ financial performance.

According to Cousins et al. (2008), a “part of the redefinition of purchasing as an important and strategic process has been to differentiate between purchasing operations, purchasing strategy and purchasing as a strategic function” (p.13). Clearly inspired by Ellram and Carr (1994) they make a distinction between *purchasing operations*, the day-to-day buying activities of the firm; *purchasing strategy*, the specific actions of the function to achieve its goals; and *purchasing as a strategic function*, when the activities and strategies of the purchasing function are aligned with the overall strategies of the firm. Ellram and Carr (1994) stress the criticality of making such a distinction, as purchasing might pursue its own operating strategies independently, with success, without considering the overall corporate strategy. However, “only when the activities and strategies of the purchasing function are aligned with the overall strategies of the firm can purchasing be a strategic function” (Cousins et al., 2008, p. 13).

Even though purchasing is regarded to be a strategic function, it still has both tactical and operational responsibilities (Monczka et al., 2011). As a means to provide the reader with further insight in purchasing, the next subsection provides important definitions and an overview of the purchasing function, together with its roles and responsibilities.

1.1.5 The purchasing function

Van Weele (2010) describes *purchasing* as “the management of the company’s external resources in such a way that the supply of all goods, services, capabilities and knowledge which are necessary for running, maintaining and managing the company’s primary and support activities is secured under the most favorable conditions”(p.3). Even though the previous subsection

(1.1.4) referred to purchasing as a strategic function, the role purchasing has in today’s organizations is not only strategic, but also of a tactical and operational nature (van Weele, 2010). This is also recognized by Monczka et al. (2011), who separate between the strategic roles and tactical responsibilities of the purchasing function (Figure 2); the latter encompassing what van Weele (2010) refers to as tactical and operational. According to Monczka et al. (2011), these roles and responsibilities are necessary in order to achieve the overall goals of purchasing within an organization: (1) ensure supply continuity; (2) manage the sourcing process efficiently and effectively; (3) develop supply base management; (4) develop aligned goals with internal stakeholders; and (5) develop integrated purchasing strategies that support organizational goals and objectives.

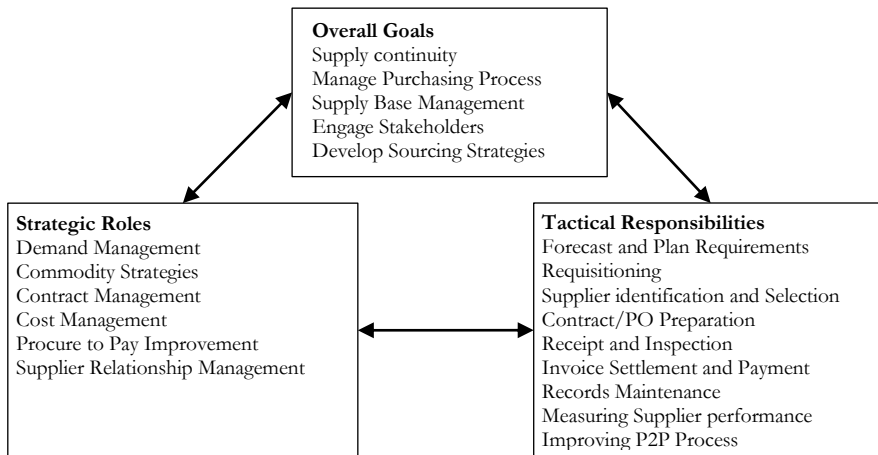


Figure 2: Purchasing’s Roles and Responsibilities: Strategic vs. Tactical (Monczka et al., 2011, p.42)

The tactical and operational responsibilities of the purchasing function

In order to support the overall goals of the purchasing function, there are several tactical (and operational) responsibilities it must attend to (Figure 2). Van Weele (2010) illustrates the main activities in the purchasing process, carried out by the *purchasing function* (Figure 3).

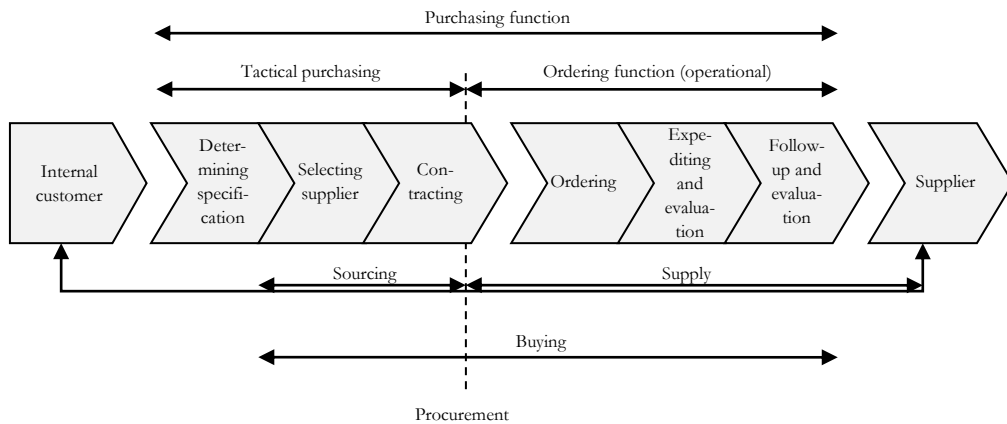


Figure 3: Purchasing process model and related concepts (adapted from van Weele, 2010, p.9)

The process starts by identifying internal needs and requirements. This helps to determine the *specifications*, in terms of quantity and quality, which the sourced product must fulfill. On the basis of the specifications, the process proceeds by prequalifying *suppliers* and requesting for quotation. Then, after receiving the quotations, a *contract* is prepared and negotiated with the selected supplier in the next step of the purchasing process. After these first three steps, termed tactical purchasing, one proceeds to what is referred to as the ordering function. Van Weele (2010) defines ordering as “the placing of purchase orders at a supplier against previously arranged conditions or when orders are placed directly at the suppliers, without questioning the supplier’s conditions”(p.30). As such, the ordering function has a more logistics-administrative, operational nature. The fourth step of the purchasing process deals with placing *orders* with the selected supplier, or otherwise develop efficient routines. Step five, *expediting*, concerns controlling that the required goods arrive at the agreed date, quality and location. The final step of both the ordering function and the overall purchasing process is, according to van Weele (2010), an *evaluation* of the supplier’s performance throughout the process.

The strategic roles of the purchasing function

With respect to the strategic roles of the purchasing function (Figure 2), Monczka et al. (2011) illustrate how the function’s strategic processes relate to each other. This is depicted in Figure 4.

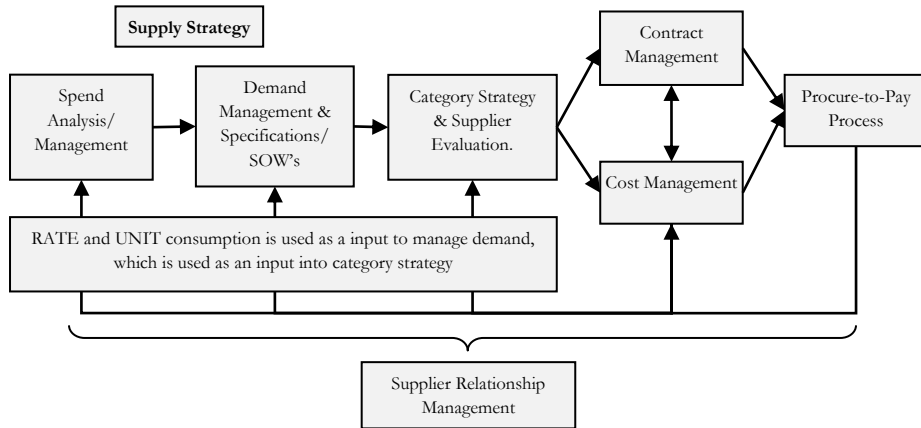


Figure 4: Core Purchasing Processes (Monczka et al., 2011, p.50)

The reader should now have an understanding of the roles and responsibilities of the purchasing function. This master’s thesis is built on the assumption that purchasing has the ability to act as a strategic function in ETO companies. We will in a subsequent chapter on purchasing portfolio approaches (chapter 3) further elaborate on how such approaches relate to the core purchasing processes (Figure 4), as outlined by Monczka et al. (2011). Next, we describe a specialization project carried out by the authors in autumn 2011, of which this master’s thesis is a continuation.

1.1.6 The specialization project as a precursor to this thesis

The specialization project titled “A Portfolio Approach to Sourcing Strategies in ETO companies” was written in the 9th semester of the authors’ master’s degree. We here give a brief summary of the project, as it constitutes a starting point for the master’s thesis. First, the research problem we set out to answer is described. Thereafter, a brief summary of important findings is provided. Finally, we point to some limitations and further research that will be addressed in this master’s thesis.

Research problem

Following in the lines of the MARGIN project (1.1.2), we set out to explore how existing purchasing portfolio approaches (PPA) can be adapted to ETO companies. The five research questions in Table 1 were formulated to answer this overall research problem.

ID#	Formulation
RQ1	What is a purchasing portfolio approach?
RQ2	What existing purchasing portfolio approaches are there?
RQ3	What is an ETO company, and what characterizes it?

ID#	Formulation
RQ4	What purchasing portfolio approaches have been recommended for ETO companies?
RQ5	How do ETO characteristics influence the applicability of a purchasing portfolio approach?

Table 1: Research questions in the specialization project

To answer these research questions, we conducted two literature reviews (ETO and PPA) and a single case study of Fugro, utilizing the systematic combining approach by Dubois and Gadde (2002). The literature review on ETO was conducted in order to reveal what an ETO company is, and what characterizes it. Further, the literature review on PPA was conducted in order to gain insight in what a purchasing portfolio approach is, and which purchasing portfolio approaches exist. Fugro was chosen as a case company to provide in-depth, and supplementary, characteristics of ETO beyond what could be identified in the literature. Additional information about this research process is included in appendix A.1. The main contribution, both to literature and MARGIN, was at the intersection between PPA and ETO (RQ5), as illustrated in Figure 5 below.

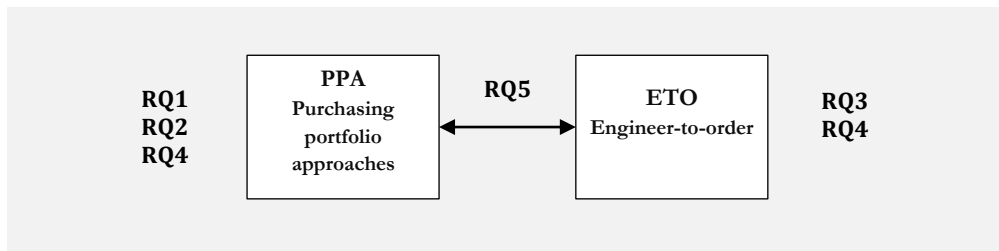


Figure 5: Relationship investigated in the specialization project; PPA – ETO

Important findings

Through comparing existing purchasing portfolio approaches, we found that they differ in terms of comprehensiveness (complexity). In the analysis, we proposed a connection between the comprehensiveness of the various purchasing approaches and the required level of sophistication (professionalism) of the purchasing function. We argued that the comprehensiveness of the approach used should match the purchasing function's level of sophistication. Consequently, we mapped the identified purchasing portfolio approaches against the sophistication of the purchasing function. We proposed that for a highly sophisticated purchasing function, the use of less comprehensive tools may be sufficient; however, we argued that the use of a comprehensive tool, by a less sophisticated purchasing function, will defeat its own end. We further argued that ETO companies can benefit from having a more professional purchasing function. Based on the case study of Fugro, ETO companies with similar characteristics as Fugro were found to have a low degree of purchasing sophistication (in terms of professionalism), and accordingly, we recommended the use of a single portfolio model, rather than a more comprehensive approach. The proposed conceptual relationship between tool complexity and purchasing sophistication is included in Figure 6 below.

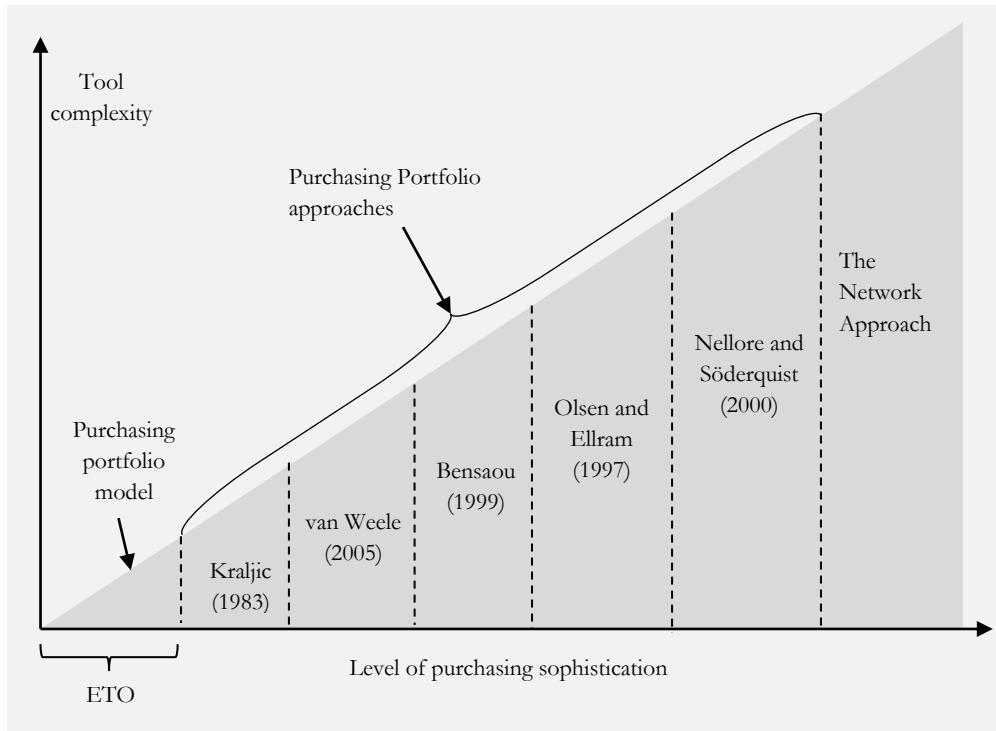


Figure 6: Proposed relationship between purchasing sophistication and tool complexity

In further answering our research problem, we adapted a portfolio model to ETO by taking the Kraljic (1983) matrix as a starting point. This portfolio model was regarded to be the least comprehensive, thus requiring the lowest level of purchasing sophistication. For ETO, we found that power balance between the buyer and the supplier limits the degree to which long-term supplier relationships are possible. Hence, we altered the horizontal dimension of the Kraljic matrix (1983) to relative power. Further we altered the vertical axis of the Kraljic matrix (1983) to degree of customization, as we suspected that this measure is easier to grasp for a purchasing function with a low degree of sophistication. By altering the dimensions in the Kraljic matrix (1983), we incorporated a concern for ETO characteristics and preserved the intention of the initial axes. We argued that the adapted portfolio model, by itself or supplemented by the Kraljic matrix (1983), could be utilized by Fugro as a means to promote cross-functional integration, which is an identified need in ETO companies. Further, it can be used as a practical tool, to understand the company's sourcing environment and increase the apprehension of the complex ETO setting. Finally, it may be used as a framework to create sourcing strategies. The proposed portfolio model is illustrated in Figure 7 below.

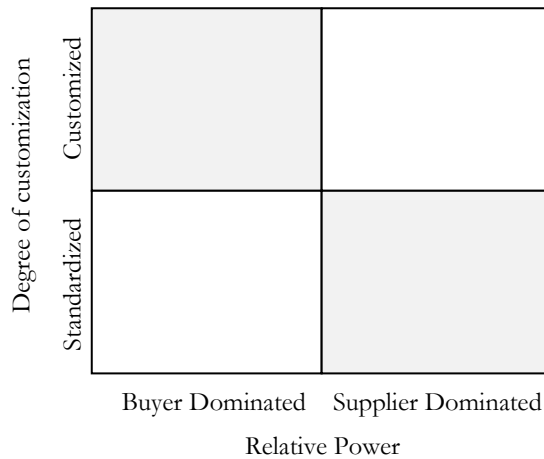


Figure 7: ETO adapted purchasing portfolio model

Limitations and further research

The specialization project brought forth interesting findings; however, we acknowledged the need for further research. The proposed relationship between tool complexity and purchasing sophistication altered the preliminary relationship between PPA and ETO (Figure 5), resulting in the possible ternary relationship depicted in Figure 8 below.

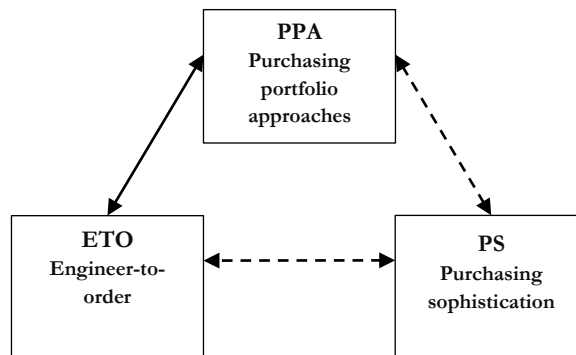


Figure 8: Ex post ternary relationship; PPA – ETO – PS

Our perception of purchasing sophistication was merely “professionalism of the purchasing function”; as such, the concept needed further research. This is illustrated by the dashed arrows in Figure 8. In addition, both the proposed relationship between purchasing sophistication and tool complexity (Figure 6) and the ETO adapted portfolio model (Figure 7) needed empirical

validation. Consequently, this is taken into account in this master’s thesis, as will be shown in the next section – describing the research problem guiding this master’s thesis, and further explaining how this relates to the specialization project.

1.2 Research problem

As shown in 1.1.6, we explored the intersection between ETO and PPA in the specialization project. This research led us to discover a possible ternary relationship (Figure 8) between engineer-to-order, purchasing portfolio approaches and purchasing sophistication. This is further investigated in this master’s thesis. We seek to explore the intersection between these research areas, and thus contribute to filling the theoretical gap with respect to ETO (1.1.3). Further, we argue that this will contribute to value creation for the MARGIN member companies, by giving recommendations as to which strategic tools to use in the creation of their sourcing strategies. This is also in line with the assumptions and goals underlying the MARGIN project (1.1.2).

As stated in the master’s thesis contract, “the purpose of this master’s thesis is to study the use of purchasing tools, especially purchasing portfolio approaches, in Norwegian engineer-to-order (ETO) companies. There will also be a focus on ETO characteristics, and their influence on purchasing in ETO companies.” In line with the problem description, the following research problem is developed: “*How does the level of purchasing sophistication affect the use of purchasing portfolio approaches in Norwegian ETO companies?*” In order to answer this, four research questions (RQ) are formulated. The problem formulation and RQs are summarized in Table 2 below.

ID	Formulation
PF	How does the level of purchasing sophistication affect the use of purchasing portfolio approaches in Norwegian ETO companies?
RQ1	What are important features of purchasing portfolio approaches, purchasing sophistication and engineer-to-order?
RQ2	What is the relationship between purchasing sophistication and the use of purchasing portfolio approaches?
RQ3	How is purchasing sophistication reflected in the purchasing practice of ETO companies?
RQ4	How can a purchasing portfolio approach be adapted to, and used by, an ETO company with similar characteristics as Fugro?

Table 2: Research questions in the master’s thesis

Figure 9 illustrates how the various research questions are related to the ternary relationship depicted in Figure 8. We have also included the research questions from the specialization project (written in parentheses) to illustrate how the master's thesis complements the project.

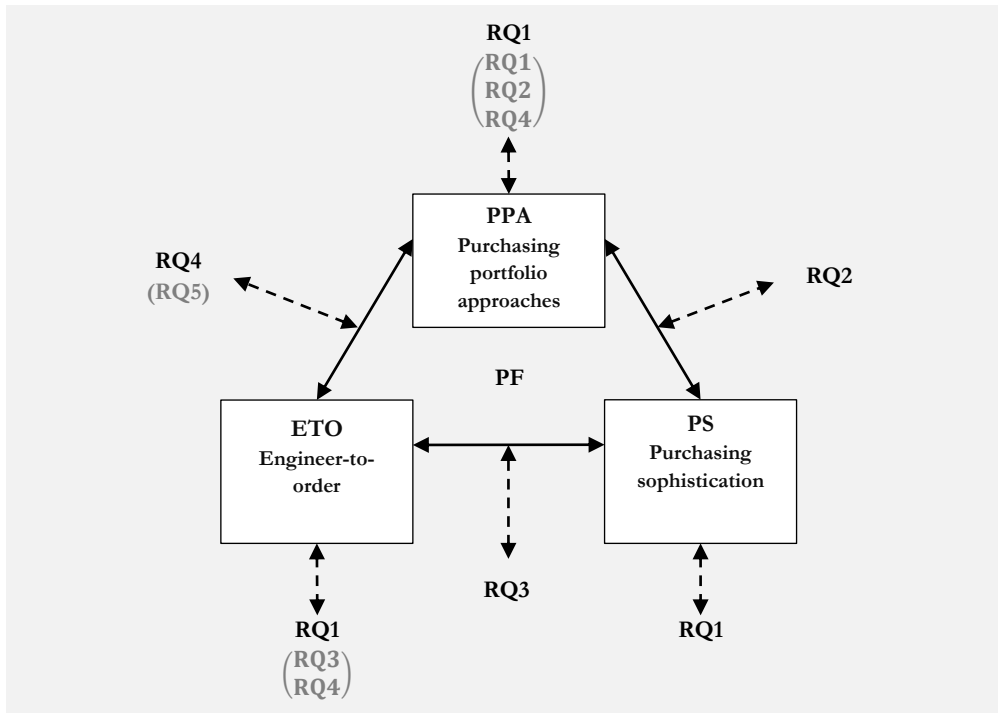


Figure 9: Conceptual framework guiding the master's thesis

By following this conceptual framework, we argue that a comprehensive investigation of the ternary relationship between engineer-to-order, purchasing sophistication and purchasing portfolio approaches is carried out. The specialization project resulted in a conceptual connection between purchasing sophistication and tool complexity, in addition to a suggested ETO purchasing portfolio model (1.1.6). In this master's thesis we wish to obtain more empirical evidence, in order to support or refute this theory. This relationship between what could be termed 'theory building' and 'testing' is illustrated in Figure 10. In the next chapter, the methodology used in this master's thesis is described.

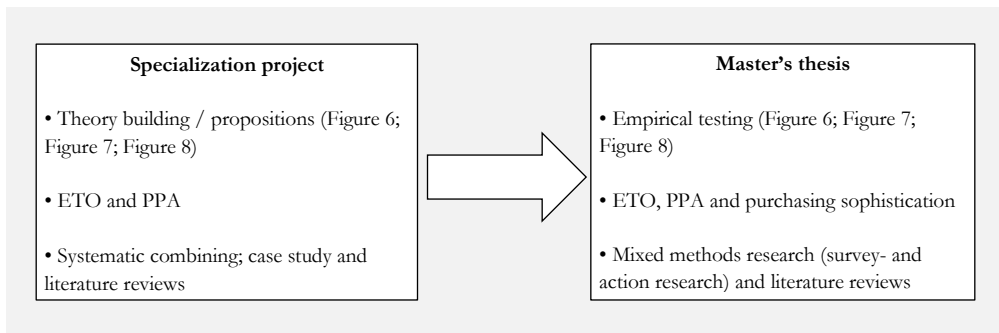


Figure 10: Relationship between the specialization project and the master's thesis

2 Methodology

The methodology used throughout this master's thesis is described in this chapter. The chapter is divided in three main parts. In the first part, an argumentation for the selection of our research methods is provided. The second part proceeds by further explaining the overall research strategy and the chosen research methods, and how they were utilized. In this part, the research strategy and methods are granted separate sections. In the third and final part, we evaluate the quality of the research process.

2.1 Selection of research methods

In this part, we present the logic underlying our choice of research methods. First, the research problem, as a point of departure, is described. Here, a description of how research questions relate to the research problem is included. Second, we illustrate how the research questions and other conditions of the study suggest different research methods. Thereafter, we discuss which research methods that seem most appropriate to answer our research questions, and decide on research methods. This part motivates the proceeding part of this methodology chapter, where the overall research strategy is introduced, and our research methods are further described. This transition is illustrated in Figure 11.

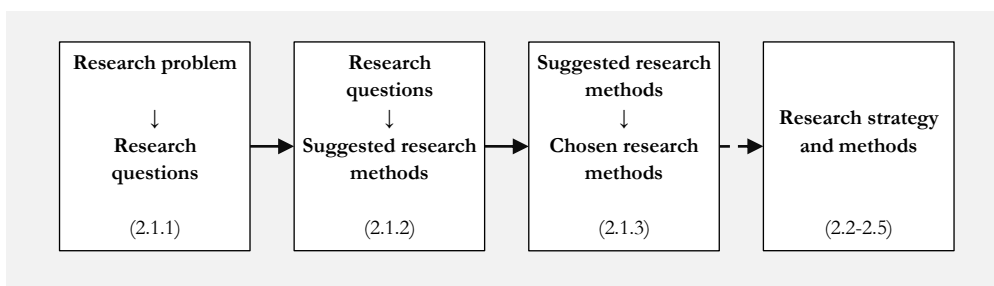


Figure 11: Overview of the first methodology part

2.1.1 Research problem

Defining the research problem is one of the more important tasks during a research process, as this will focus the succeeding research process (Walliman and Buckler, 2008). Furthermore, clearly defining the research problem and narrowing it down to the greatest extent possible is necessary, as the research methods used to obtain the answer to the problem are often new, and thus time consuming (Walliman and Buckler, 2008). Johannessen et al. (2011) state that in order to design a research problem, one must answer two questions: *who* and *what* is to be investigated? Thus, a good problem formulation clearly shows who and what is to be researched.

One method for investigating the research problem is to define a set of research questions, whose answers will require researching different aspects of the main problem. These research questions, which are derived from the main research problem, will present what is to be the subject of investigation and imply (an) appropriate method(s) for reaching an answer to the problem (Walliman and Buckler, 2008). Walliman and Buckler (2008) state that the main research problem is often quite general; however, by creating these research questions one can

direct the research to those issues which are most important. As the main research problem and the research questions provide the framework for the master's thesis, it is recommended that time is spent refining these questions in order to ease the remaining research process (Walliman and Buckler, 2008).

Developing the research problem

At the outset of our master's thesis, we had solid foundation and understanding of ETO and purchasing portfolio approaches from a theoretical point of view. However, we wanted to enhance our understanding of the concepts through empirical testing of our gained knowledge and the proposed theoretical developments, including purchasing sophistication (1.2). With respect to Johannessen et al. (2011), our research problem (1.2) clearly shows *what* is to be investigated (purchasing sophistication and purchasing portfolio approaches), and *who* is to be investigated (Norwegian ETO companies). Thus, the problem formulation neatly describes the ternary relationship described in the introduction (1.1.6 and 1.2). Further, we specified four research questions within this overall research problem, to further specify our research (1.2; Table 2). In the next subsection, we describe suggested research methods, given the research questions and other conditions of the study.

2.1.2 Suggested research methods

Several authors argue that the research questions should be taken as a starting point when choosing the appropriate research method(s) (e.g. Walliman and Buckler, 2008; Teddlie and Tashakkori, 2009; Yin, 2009). In order to avoid the usage of a less advantageous research method, Yin (2009) provides three different conditions in which one can separate between such methods: *The type of research question; the extent of control over behavioral events; and the degree of focus on contemporary as opposed to historical events.* Table 3 depicts how the different methods are divided dependent on the conditions of the study. In the next subsection, we take this into consideration, and discuss and decide on which research methods to utilize.

Method	Conditions		
	Form of Research Question	Requires Control of Behavioral Events?	Focuses on Contemporary Events?
Experiment	How, Why?	Yes	Yes
Survey	Who, What, Where, How Many, How much?	No	Yes
Archival analysis	Who, What, Where, How many, How much?	No	Yes/No
History	How, Why?	No	No
Case Study	How, Why?	No	Yes

Table 3: Relevant situations for different research methods (Yin, 2009, p.8)

2.1.3 Deciding on research methods

When deciding on research methods, our research questions are evaluated in light of the different conditions provided by Yin (2009), as described in Table 3 above. The result of this comparison is given in Table 4 below.

Research questions	Form of Research Question	Requires Control of Behavioral Events?	Focuses on Contemporary Events?	Recommended method by Yin (2009)	Choice of method
RQ1: What are important features of purchasing portfolio approaches, purchasing sophistication and engineer-to-order?	Who, What , Where, How Many, How much?	No	No	Archival analysis	Literature review*
RQ2: What is the relationship between purchasing sophistication and the use of purchasing portfolio approaches?	Who, What , Where, How many, How much?	No	Yes	Survey	Survey
RQ3: How is purchasing sophistication reflected in the purchasing practice of ETO companies?	How , Why?	Yes	Yes	Experiment	Action research
RQ4: How can a purchasing portfolio approach be adapted to, and used by, an ETO company with similar characteristics as Fugro?	How , Why?	Yes	Yes	Experiment	Action research

Table 4: Deciding on research methods

From Table 4, we see that our choice of method for several of the research questions deviates from what is recommended by Yin (2009). Hence, we see it appropriate to present our evaluation underlying the choice of research methods. This is done in the three following paragraphs.

Choosing to conduct a literature review*

From Table 4 we see that the recommended research method for answering our first research question is archival analysis, as the research question neither requires control of behavioral events, nor focus on contemporary events. We do, however, argue that a literature review is more suitable for answering this question, as archival analysis typically refers to the treatment of archival records to explain an incidence (Yin, 2009); e.g. the outcomes of a new university grading policy, based on analysis of students' certificates before and the implementation.

Yin (2009) states that thorough literature reviews are done *prior* to the choice of a research method; hence, he neglects it from Table 3. He argues that the purpose of a literature review is not to find a definite answer on what is known on a topic; rather it is a means for developing improved research questions (Yin, 2009). Dubois and Gadde (2002) argue that a literature review is an important method for developing a theoretical framework. Walliman and Buckler (2008) follow in the same lines, arguing that a literature review outlines the theoretical aspects and previous research of an investigated phenomenon. Based on our intention of developing a theoretical framework for subsequent gathering of empirical data and analysis, we feel that our choice of a literature review to answer the first research question is well justified. The literature reviews are briefly described in 2.5.

In Table 4 and this paragraph heading, we have included an asterisk. This is done to emphasize that the first research question is not solely answered by the aforementioned literature review. Due to our mixed methods empirical investigation (Part II), we discovered that the empirical data enabled us to refine the framework. As such, RQ1 is intermediately answered at the end of our theoretical foundation (Part I) through a literature review, and brought to a conclusion by supplementing with survey- and action research findings in the first chapter of the analysis (chapter 8). The refined framework was further used to guide the subsequent analysis of the ternary relationship between purchasing portfolio approaches, purchasing sophistication and engineer-to-order (chapter 9-11).

Choosing to conduct survey research

As a means to answer our second research question in a satisfying manner, we have chosen to utilize a survey research method. This choice of research method is in accordance with the recommendations provided by Yin (2009), as the research question starts with "what", thus qualifying for the use of either survey or archival analysis. Furthermore, the question is of an exploratory nature, favoring the use of a survey method. A further argument for choosing to conduct survey research is that we have no control of the researched phenomenon in this incident; we are in no position to influence the relationship between the use of purchasing portfolio approaches and purchasing sophistication. In addition, the research question has a

contemporary focus. In conclusion, we see that our use of a survey research method is well justified according to Yin (2009). The survey research is further discussed in 2.4.

Choosing to conduct action research

If we were to follow Yin (2009), experiments should be chosen as a research method for both RQ3 and RQ4. According to Yin (2009), experiments should be conducted when the researcher “can manipulate behavior directly, precisely, and systematically” (p.11). Further, Yin (2009) proposes that appropriate arenas are either a laboratory where variables can be isolated, or a field setting where different groups of research objectives are treated differently.

As stated in the introduction (1.1.2), we have chosen Fugro as a collaborative partner in this master’s thesis. No company within MARGIN possesses the same characteristics as Fugro; hence, an experiment with several “social groups”, as proposed by Yin (2009), is impossible to conduct. Further, we are not in position to manipulate the work context and fully isolate variables of interest in Fugro. This already implies that classic experiments are less appropriate for answering our research questions.

Further, we wish to test and introduce knowledge and frameworks developed. This is done in order to identify processual and social aspects of using purchasing portfolio approaches, and to generate new knowledge, both for us and the partner company. In addition, we argue that an investigation of an ETO company’s purchasing sophistication can only be fully accomplished by challenging the employees of the company. In order to achieve this, we identify a need to involve ourselves in the research context, in order to extract information of a processual and social nature. We argue that simple interviews, or “outsider observation”, will not yield the type of information needed. In search for a more suitable research method, we came to the conclusion that *action research* is the most appropriate research method available to answer RQ3 and RQ4. Action research is further described in a succeeding section (2.3); however we briefly describe it here, in order to justify our choice.

Action research is not one of the research methods proposed by Yin (2009), but bears resemblance to what he calls *quasi-experiments*. The methods differ in that the researcher actively takes part in the research context in action research, whereas the researcher has a more objective role in experiments. Conducting action research, one seeks to generate new knowledge both for a problem holder and an action researcher, through collaborative problem solving in real life situations, having a dual aspect of research interest in mind (Greenwood and Levin, 2007; McKay and Marshall, 2001; Gummesson, 1991; Klev and Levin, 2009). Here, the researcher actively takes part in the context of the research objects, and can facilitate testing and the introduction of both developed knowledge and frameworks, at the same time as identifying processual and social aspects of the research phenomenon (through social interaction and participant observation). All in all, we feel that action research meets our requirements for a research method that corresponds to the nature of the research questions considered, and the chosen empirical setting.

In the next section, we describe how the chosen research methods are gathered under the same banner; the mixed methods research strategy. Subsequently, we further elaborate on the respective chosen research methods.

2.2 Mixed methods research strategy

As apparent from the above discussion on choice of research methods, the selection includes both qualitative (action research) and quantitative (survey research) research designs, with literature review falling outside of this classification. We see it beneficial to structure our methodology under an overall research strategy. Based on the prevalence of both qualitative and quantitative research methods, the overall research strategy deemed suitable is *mixed methods research*. This will be further elaborated in the next subsection. Thereafter, two subsequent sections provide thorough descriptions of the action research and survey research methods, with both theory and descriptions of our execution. A section describing the literature review is then included. Figure 12 illustrates the relationship between these sections.

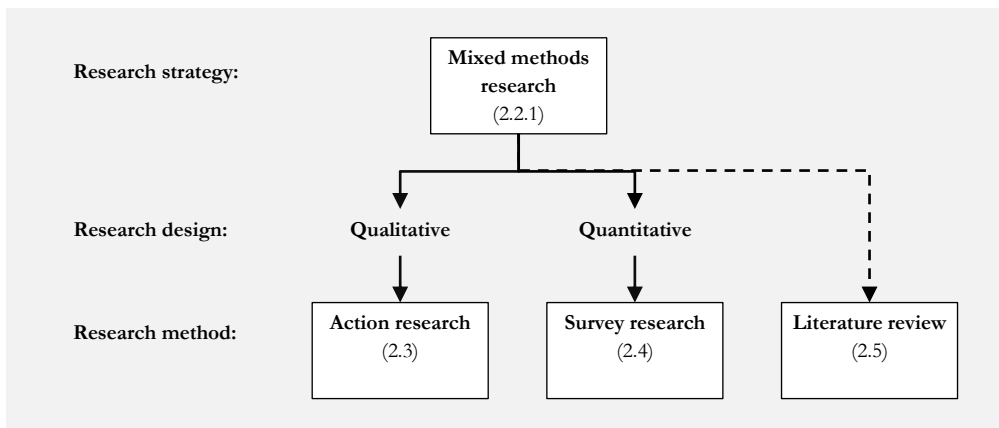


Figure 12: Overview of the second methodology part

2.2.1 Mixed methods research strategy

Mixed methods research can be defined as a project that involves both quantitative and qualitative methods (Leech, 2010; referred to in Teddlie and Tashakkori, 2009). The approach cuts across these two different research designs, and the data extracted from these strategies are to be mutually illuminating (Bryman and Bell, 2007). As seen in the previous part, the research questions dictate the choice of research methods, which again decide the applicability of a mixed methods research strategy. Hence, we see that the research questions are a driving force for the choice of mixed methods research. This is recognized by several authors (e.g. Teddlie and Tashakkori, 2009; Onwuegbuzie and Leech, 2006).

Applications of mixed methods research

Bryman and Bell (2007) provide five applications of mixed methods research. These applications are summarized in Table 5 below.

APPLICATIONS OF MIXED METHODS RESEARCH	
Application	Description
<i>Qualitative research can facilitate quantitative research</i>	Qualitative research can be used as a source for hypotheses or hunches that subsequently can be tested using quantitative methods, and the deep knowledge gained from qualitative research can be used to aid the design of survey questions
<i>Quantitative research can facilitate qualitative research</i>	Quantitative research can guide qualitative research through pinpointing interview objects or case companies that seem to be of interest for further qualitative research
<i>Mixed methods research can both cover static and processual features of an investigation</i>	Quantitative research can provide a static picture of social life, while qualitative research can discover more processual features of a study
<i>Qualitative research may facilitate the interpretation of the relationship between variables</i>	Qualitative reasoning may for instance reveal the occurrence of an intervening variable – a variable influenced by an independent variable that further influence the dependent variable
<i>May be an approach of hedging risk in terms of securing empirical data</i>	For instance, survey responses may be too few to use for generalization, making use of other data sources a necessity

Table 5: Applications of mixed methods research (adapted from Bryman and Bell, 2007, pp.645-656)

Applying the mixed methods research strategy

In relation to the first application, our understanding of the ETO context, gained from the specialization project (1.1.6), has inspired the development of several questions used in the questionnaire (A.3). With respect to the second application, the questionnaire may reveal interesting findings with respect to company size, industry, production situation, and turnover and so on, providing valuable information when analyzing the qualitative part of this study. As for the third application, the survey will contribute to give a static view of the use of purchasing portfolio approaches, while action research will contribute to map the process around the practical use of these same models, together providing a more holistic and comprehensive view of the use of purchasing portfolio approaches. We also recognize that our qualitative study can cast an additional light on results from the survey, explaining possible correlations in depth, relating to the fourth application (Table 5). Finally, the fifth application is also relevant for this thesis; there is less risk associated with our qualitative data collection than with our survey, making it an attractive research method for the authors. Hence, we see that all the applications are employed in our master's thesis research, which again supports the choice of a mixed methods research strategy. As such, the research questions will not solely be answered by the corresponding research method (Table 4); multiple methods will provide stronger reasoning. In the next section, the action research method is described.

2.3 Action research

As previously mentioned, action research is conducted to address two research questions in this thesis (2.1.3). We will in this section introduce the method of action research, address critique and practical implications of the method, and map the design used to approach the research questions of interest. Thereafter, the quality of the action research is assessed, taking critique of action research into account.

2.3.1 Action research defined

Action research originates from two research environments; one surrounding Kurt Lewin at MIT; the other at Tavistock Institute in London, comprising researchers as Eric Trist, Fred Emery and Philp Herbst (Klev and Levin, 2009). Action research is a research method that has been discussed and utilized for many years in scientific research. Handbooks has been written (e.g. Reason and Bradbury, 2001; Greenwood and Levin, 2007) and scientific journal published on the subject (e.g. International Journal of Action Research; Action Research; Systemic Practice and Action Research) to address various issues related to the method; for instance epistemological foundations (Greenwood and Levin, 2007) and cyclical approaches to action research design (McKay and Marshall, 2001; Burns, 1994). Action research is maybe the one stream that has provided the most influential contribution to overarching academic understanding of grounds for organizational development, but still; action research is looked upon as an outsider in the social sciences (Klev and Levin, 2009).

To encapsulate the different aspects of this research method, Hult and Lennung (1980) gives a rather comprehensive, but elucidating, definition of the term: “Action research simultaneously assists in practical problem-solving and expands scientific knowledge, as well as enhances the competencies of the respective actors, being performed collaboratively in an immediate situation using data feedback in a cyclical process aiming at an increased understanding of a given social situation, primarily applicable for the understanding of change processes in social systems and undertaken within a mutually acceptable ethical framework.” (p.247)

This definition captures the very essence of action research; it represents a combination of action (practice) and research (theory) (McKay and Marshall, 2001; Gummesson, 1991). Action research seeks to generate new knowledge both for a problem owner and an action researcher, through collaborative problem solving in real life situations, having a dual aspect of research interest in mind (Greenwood and Levin, 2007; McKay and Marshall, 2001; Gummesson, 1991; Klev and Levin, 2009). Different from many other research methods, action research relies on the researcher(s) actively taking part in the context of his/her research interest area, shaping a mutual reliance on the problem owner’s and the researcher’s skills and competences, focusing on “doing with”, rather than “doing for”, the counterparty (Greenwood and Levin, 2007; McKay and Marshall, 2001; Gummesson, 1991; Klev and Levin, 2009). The approach of action research provides opportunities for gaining authenticity and good insight to the problem and the problem holder (Gummesson, 1991).

For conducting satisfactory action research, it is important that the *arena* for learning is well configured, and the process well planned (Greenwood and Levin, 2007; Klev and Levin, 2009).

Greenwood and Levin (2007) argue that the arena has to stimulate a process of discussion and reflection between the problem owner and the researcher; processes that in this way produce knowledge in a co-generative manner. In the arena, an asymmetry in skills and knowledge of the problem in hand exists; the problem owner (insider) has superior knowledge of the problem compared to what the researcher (outsider) holds, while the researcher contributes with skills, knowledge and perspectives that the problem owner does not possess (Greenwood and Levin, 2007). This asymmetry is an important driving force in action research, as the parties will have to enlighten each other, in this way stimulating discussion and reflection that hopefully approaches a problem from a different angle (Greenwood and Levin, 2007).

Action research is often looked upon as an exclusively qualitative method; however, Greenwood and Levin (2007) and Gummesson (1991) argue that this is wrong. These authors claim that action research actually can take a mixed methods approach – as long as it is clear that the focal mix of methods is contextually determined. Like other research methods, action research is prone for critique; the next subsection elucidates this.

2.3.2 Critique of action research

As an outsider in research methodology, action research and its practitioners have had to meet various types of critique over the years. *First*, action research has been looked upon as nothing more than consultancy, helping the problem holder with a problem, and not emphasizing the research in a sufficiently (scientific) manner (McKay and Marshall, 2001). *Second*, it is argued that causal inferences cannot be made safely (Baskerville and Wood-Harper, 1996). *Third*, in action research the researcher is said to be especially exposed for bias, as the researcher actively is taking part in the activities; rather than being an objective outsider (McKay and Marshall, 2001). Action research is also prone to the general critique of qualitative research; that it is hard to make generalizations from this type of research design, and it hence lacks some key criteria for good research (McKay and Marshall, 2001; Bryman and Bell, 2007). In our research, we have taken this into account, and tried to mitigate this critique as much as possible. In the later evaluation of the action research (2.3.5), our mitigation of the critique is addressed. Next, a dual imperative approach to action research, which we have adopted, is presented.

2.3.3 A dual imperative approach to action research

McKay and Marshall (2001) note that the usual depiction of an action research process is a cycle of one or more iterations; Susman and Evered (1978), Burns (1994) and Checkland (1991) all use this approach to the process. Klev and Levin (2009) propose a model called the ‘co-created learning model’, seeking to systemize and structure learning processes through structuring the interplay between the problem holder and external researcher. Not dissimilar to this model, McKay and Marshall (2001) have a dual approach to the action research process, arguing that action research is a juxtaposition of problem solving and research. They represent their process by two separate cycles; one for the problem solving and one for the research interest. These are illustrated in Figure 13 below, and further elaborated on in the subsequent paragraphs.

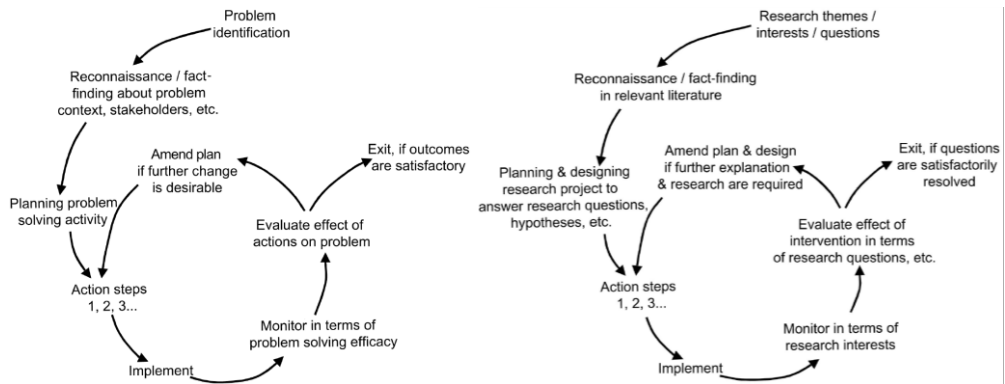


Figure 13: The problem solving (left) and research interest (right) in action research (McKay and Marshall, 2001, pp.50-51)

Problem solving interest

The problem solving interest of action research starts, according to McKay and Marshall (2001), with *problem identification*; what is the real life problem of the problem owner to be solved and researched? Next, a process of *fact finding* is to be executed; identifying the problem context, key stakeholders, and other issues of relevance, like history, culture and politics. In the *planning* phase, the researcher plans the problem solving strategy and activity, in collaboration with the problem holders if needed, resulting in a number of *actions* and *implementation* steps. These actions are then tried realized, closely *monitored*, for then to be *evaluated*. Next, McKay and Marshall (2001) argue that one either *exits* the cycle, if the results are satisfactory, or one makes *adjustments* in the process and continues in the cycle until a satisfactory result exists.

Research interest

The research interest cycle has its starting point *in research questions* or areas of interest that have caught the author(s) attention, in which the problem holder also will be a relevant research unit (McKay and Marshall, 2001). As in the problem solving cycle, a *fact finding* phase is needed, before the action researcher(s) has to *plan and design* how to approach the research questions in practice. One then proceeds, having a theoretical foundation from the planning phase as a basis. As in the problem solving cycle, *actions*, with following *implementation*, are then *monitored* and *evaluated*, resulting in either *exiting* the cycle or making *adjustments* to the approach until satisfactory answers to the research questions of interest are found (McKay and Marshall, 2001).

Duality

McKay and Marshall (2001) emphasize that the two action research cycles are not independent, but actually contingent on each other. These authors argue that action researchers need to consider both the problem solving and the research interest in action research, resulting in a clearer picture both for the researcher and the research consumer.

The approach by McKay and Marshall (2001) is adopted for the research conducted in this thesis, as the approach clearly separates the two interests of action research, making it easier to

design the action processes with regards to both problem solving and research interest. Next, we elaborate on how we conducted the action research.

2.3.4 Conducting action research

The methodology used in this thesis is following in the lines of action research; seeking to generate new knowledge, through collaborative problem solving, both for the authors and the problem holder. However, due to lack of resources and time, the research done is restricted to only comprising the start of a preferably longer process together with the problem holder. This master's thesis is only a short-term operational piece in the larger and longer term puzzle; the MARGIN project. The theoretical foundation, the research's intention, the design of the learning arena and process, and the first steps of collaboration with the problem holder are all based on action research, while subsequent steps of implementation, monitoring and doing adjustments have to be continued by the problem holder together with a third part. Even though action research may also be used as a quantitative research method (2.3.1), we will only utilize its potential as a qualitative research method. Next, we describe how we conducted the problem solving and research interest cycles, respectively.

Addressing the problem solving interest

In this thesis, action research was conducted together with our partner company, Fugro (problem holder). In line with MARGIN's guidelines, it was important that our collaborating partner would reap benefits from the cooperation. We argue that the problem solving interest, with Fugro as problem holder, would provide such a benefit. We followed the guidelines provided by McKay and Marshall (2001) (2.3.3), and the applied cyclical approach is depicted in Figure 14 below.

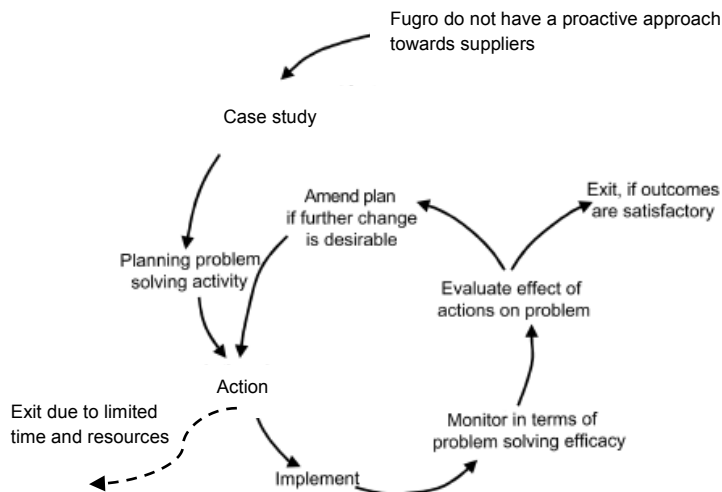


Figure 14: Action research problem solving framework used (McKay and Marshall, 2001)

The problem identification process (step 1) was done in two stages, prior to this master's thesis. First, a mapping of the problem holder and relevant problem areas was conducted by SINTEF, HiST and the company itself. This resulted in an identification of upstream activities, as supplier collaboration, to be one of MARGIN's four research areas (Margin, 2011d). The second stage of problem identification was carried out in autumn 2011, when the authors conducted a case study of Fugro (1.1.6). The problem identification was done together with the technical manager of Fugro and one of the purchasers. As such, we got thorough insight in both purchasing practice and the engineering-purchasing interface. This research revealed a need for more proactive purchasing, and a possible facilitation of this by adapting a purchasing portfolio approach to the ETO production situation. This case study also mapped the context (step 2) of the case company, providing invaluable information that shaped the subsequent process in the action research.

Planning of the problem solving activity (step 3) was then conducted together with the case company, agreeing on the arena, participants, form and practical issues of the activity. We planned two sessions, termed "workshops", with the company, including participants from different functions in Fugro. In the first session, representatives from purchasing were to be present, whereas purchasing, sales/marketing and engineering were to be present in the second. These were chosen because we wanted to investigate whether it is beneficial to include several functions when conducting purchasing portfolio analysis. An action research protocol (A.2) was also made, functioning as a "game plan" for the workshops and making sure that both the research and problem solving interest were met.

The proceeding action step constituted the actual problem solving activity (workshops). In detail, the action step took the form of introducing purchasing portfolio approaches to the case company – seeking to implement a more proactive and systematic process for approaching suppliers. The authors were active in this process, introducing the portfolio approaches and trying to facilitate a good use of them. This process was also closely monitored by the authors, and then evaluated together with the case company. At the end of the workshops, a total evaluation was made by the problem holder. As planned, the action research was conducted over two sessions with two different groups of employees. The first workshop comprised of the researchers and two purchasers; the second workshop comprised, however, only of the researchers, marketing/sales and engineering, due to uncontrollable occurrences at the case company. This will be further discussed in the subsequent evaluation of action research (2.3.5). Each session lasted for about two hours.

As mentioned above, due to lack of resources and time, the action research process was cut after the action step (step 4), leaving the subsequent steps yet to be conducted. This is also illustrated in Figure 14 above. The authors' contribution to the case company has therefore been to introduce a tool for pro-active and systematic sourcing, purchasing portfolio approaches, through problem identification and the action step.

Addressing the research interest

The previously described research interest cycle framework was employed when approaching the research interest; this is depicted in Figure 15 below. The research questions to be addressed through the use of action research (RQ3 and RQ4; 1.2), were derived from the research conducted in the specialization project (1.1.6), where we utilized the systematic combining approach by Dubois and Gadde (2002) (A.1). This constituted step 1 and 2 in the cycle, guiding the subsequent steps. With respect to step 2, we also conducted literature reviews; providing us with a solid theoretical basis for conducting the action research. Further, the planning phase took the form of making an action research protocol (further described below). The activity of action was then conducted, as described in *addressing the problem solving interest* above. Again, our research ended with the action step, due to the reasons previously mentioned.

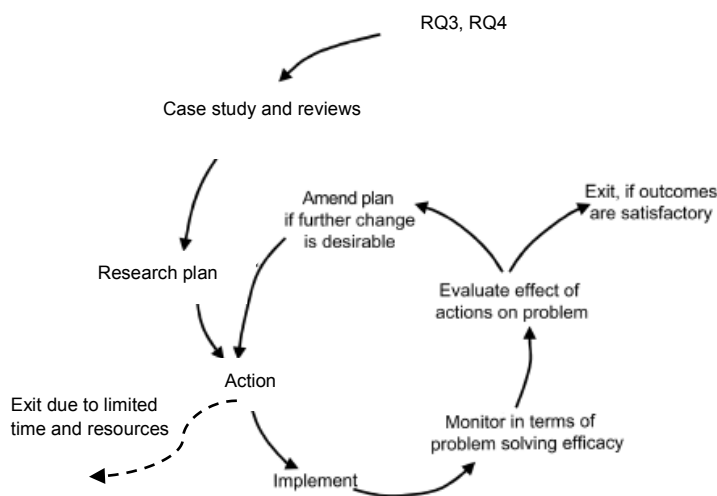


Figure 15: Action research framework for research interest used (McKay and Marshall, 2001)

Use of action research protocol

To make sure that we addressed all relevant areas of interest, with respect to both problem solving and research, an *action research protocol* was developed during the planning step. The protocol's purpose was to guide the action step in the action research approach, making sure that all relevant research questions and problem issues were met in a good manner. The protocol served as a "game plan" in the collaboration sessions with the case company, but did not serve as a traditional interview guide, as the authors wanted to stimulate discussions, joint problem solving and co-generative learning. We were, however, inspired by theory on interviews (especially semi-structured interviews) when developing the action research protocol.

Due to the nature of action research, where the investigator is a part of co-generative learning, we saw a need for enhanced flexibility and extended answers from the problem holder. As such, a *semi-structured* interview form seemed fit as a basis for our action research protocol and the execution of the workshops, as this form provides the investigator with enhanced flexibility, as

an answer can be supplemented with questions in order to extend the depth of information (Walliman and Buckler, 2008; Johannessen et al., 2011). This type of interview often takes on a conversational manner and is open-ended, but is likely to follow a certain set of questions derived from the research questions (Walliman and Buckler, 2008). Here, the use of *open questions* invites the participants to provide extended answers, and can be achieved by asking “why” (Walliman and Buckler, 2008).

The two sessions with the case company were identically designed, but the process in the sessions went in different directions; reflecting the flexibility of the protocol. This was expected, as different organizational members contributed in the different sessions, shaping the process itself. The authors found it extremely valuable, as different problems and information came to light, at the same time as the problem holders also preferred this somewhat semi-structured arena. The action research protocol was also organized in terms of topics, as such indirectly determining how the session should proceed. The protocol is included in appendix A.2.

2.3.5 Evaluating the action research

As previously mentioned (2.3.4), we have chosen to utilize action research’s potential as a qualitative research method. Hence, we evaluate the action research quality through criteria developed for qualitative research. There is a discussion among academics concerning appropriate research criteria for qualitative research, varying in degrees whether a simple application of a quantitative researcher’s criteria of reliability and validity is desirable (Bryman and Bell, 2007). For this thesis, we choose to adopt the criteria of construct -, internal and external validity, and internal and external reliability, following in the lines of Bryman and Bell (2007) and Yin (2009). Each of these criteria is evaluated below. We also present how we sought to mitigate critique of action research (2.3.2), and finally point towards some potential weaknesses of the action research.

Construct validity

Research is said to have construct validity if the correct operational measures for the concepts being studied are identified (Yin, 2009). In order to achieve construct validity, we have used multiple sources of evidence throughout the action research process. In the various steps in the action research process, from problem identification to taking action, various research methods and sources has been used. In the problem identification and fact finding activities, literature reviews on ETO and purchasing portfolio approaches were conducted. Further, mapping of the problem holder, both by SINTEF/HiST and the authors were conducted (2.3.4), prior to and through a case study carried out in the specialization project (1.1.6), respectively. These multiple sources of evidence have enabled us to triangulate the data, providing multiple measures of the same phenomena, and hence addressing construct validity. In the action stage of the process, we conducted two workshops with the same research design. Different people addressed the same problems; as such, purchasing practice in Fugro was further mapped with multiple sources, which reduced person specific biases and enhanced the construct validity.

Internal validity

With respect to internal validity, one should be able to separate causal relationships between two or more constructs, from spurious relationships (Yin, 2009; Bryman and Bell, 2007). According to Yin (2009) internal validity is measured for explanatory or causal studies only. As our action research is exploratory in nature, it is difficult to address the internal validity of this research.

External validity

To achieve external validity, the domain to which a study's findings can be generalized must be defined (Yin, 2009). Ringdal (2001) stress that when one case company constitutes the point of departure, it is important to differentiate between the findings that are general and those that are company specific. We argue that this is very much relevant when doing action research. Consequently, we have compared our findings with findings in theory, in order to reveal the domain to which our findings can be generalized. The mixed methods research strategy (2.2.1) further strengthens the external validity.

Internal reliability

According to Bryman and Bell (2007), internal reliability is whether or not, when there is one or more observers in a research setting, members of the research team agree about what they observe. Throughout all interaction with the partner company, the research team has consisted of the three authors. In addition, one researcher from SINTEF was present at the workshops. We also recorded the workshops; enabling us to go back to occurring events in retrospect. Through good discussions, the research team has together made conclusions on the empirical data gathered, leading to balanced and more objective inferences. Hence, the internal reliability is well accounted for.

External reliability

For a research to be reliable, a replication of its operations must lead to the same results (Yin, 2009; Bryman and Bell, 2007). In order to achieve this, we have thoroughly documented our study and choices. We have used an action research protocol, which has guided our action research (2.3.4; A.2). The design of the action research can hence be replicated, and the researcher(s) can take the same role. We do, however, acknowledge the process itself will be impossible to fully replicate, due to the idiosyncratic context of the researchers and the problem holder.

Mitigating critique of action research

Critique of action research was described in 2.3.2. We have done our utmost to mitigate this critique. First, concerning the argument of consultancy, we feel that our adoption of the dual imperative approach to action research, explicitly addressing and acknowledging the research interest, has mitigated the potential problem of action research being no more than problem solving for the company. That being said, we acknowledge that the problem solving interest actually *is* similar to consultancy; however, as we designed our action research sessions to explicitly focus on both research *and* problem solving, we feel that the quality of our research holds on this area.

For mitigating the potential bias of impartiality, we utilized a research team comprising three persons; two taking part in the activities with the problem holder, and one observing and transcribing the events. We feel that a team based approach, where the researchers have different roles, is a very good way for mitigating the potential bias. As such, we would recommend this approach to action researchers in the future. We also wish to point out that the aspect of the researcher(s) taking part actively in the sessions was invaluable for our research process, yielding more and better information from the problem holder, which both contributed to better problem solving and research findings. Paradoxically, the subjectivity issue in action research has only strengthened our research, through taking both a subjective and an objective role.

Mitigating the critique of generalizability and causal inferences is already evaluated in terms of external and internal validity, respectively (see above). Next, we assess weaknesses with the conducted action research.

Weaknesses with the research

While being satisfied with the action research in general, some elements of the research did not go as planned. First, the workshops' design was maybe too comprehensive, leading us to give less priority to one of the models that were tested. This may have led to a more subjective problem-solving practice than was wanted, in that the authors "controlled" the appliance of the respective model. Second, uncontrollable occurrences at the case company led fewer employees from the problem holder to attend the sessions – this was detrimental to the cross-functional teamwork that was intended in the workshops. As such, we got less information on the pros and cons of working in cross-functional teams when doing purchasing portfolio analysis than was wanted. Nevertheless, it was still interesting and of value to observe how the different functions evaluated aspects in both similar and dissimilar ways. Lastly, as mentioned, due to time and resource limitations, we were not able to follow the problem holder longer than to the "action" step in the action research. More time and access to the problem holder would be needed in order to complete the action research cycles. As such, we have only been able to introduce purchasing portfolio analysis to an ETO company, and acknowledge that valuable insight and knowledge may be gained if one were able to complete the whole duality cycle.

In summary, we feel that we have conducted action research in a satisfactory manner, albeit we acknowledge that the research is not without its weaknesses. By consciously taking precautions and documenting the process thoroughly, we argue that we have conducted action research of high quality. We feel that the action research has provided value – both for the problem holder and the researchers. In the next section, the survey research is presented.

2.4 Survey research

This section provides a description of the survey research methodology. First, an introduction to survey research is provided, including a definition of survey research and criteria for evaluating quality of such a quantitative research method. Thereafter, principles for developing a

questionnaire are described, followed by a description of concerns to be taken when distributing the questionnaire. A presentation of relevant methods for analyzing the data collected from the questionnaire is then provided, before elucidating the major critique of survey research. Finally, an evaluation of our survey research is presented.

In the subsections concerning the construction and distribution of the questionnaire, we start with defining the theoretical background, before describing how we have taken this into consideration when conducting our research; ‘-’ separate these in the text. The theory mainly stems from Bryman and Bell (2007), and other references will be stated explicitly when used.

2.4.1 Introduction to survey research

Bryman and Bell (2007) define the term *survey* (survey research) as research “that employs cross-sectional research design and in which data are collected by questionnaire or structured interview” (p.56). Here, a cross-sectional research design implies the “collection of data on more than one case and at a single point in time in order to collect a body of quantitative or quantifiable data in connection with two or more variables, which are then examined to detect patterns of association” (p.55). We will adopt this definition of survey research, and use questionnaire as an expression of the tool which is utilized to collect data.

In order to ensure the quality of quantitative research, Bryman and Bell (2007) suggest the use of three prominent criteria; *reliability*, *replication* and *validity*. Reliability concerns the extent to which a measure of a concept is stable, and thus the ability to repeat the results of a study, whereas replication concerns whether the research procedure can be replicated. The most important determinant of quantitative research quality is validity, which “is concerned with the integrity of the conclusions that are generated from a piece of research” (Bryman and Bell, 2007, p.41). Validity can further be segregated into four different sub-groups: measurement (construct); internal; external; and ecological validity (Bryman and Bell, 2007). A description of these different types of validity is provided in Table 6, as they are important concerns when ensuring the survey research quality.

	Type of Validity			
	Measurement (Construct)	Internal	External	Ecological
Description	Concerns to which extent a <i>measure</i> that is devised of a concept actually does reflect this concept.	Handles the issue of <i>causality</i> . How certain can one be about the casual relationship between two or more variables?	Can the results derived from the study be <i>generalized</i> beyond the unit of analysis to a wider similar context?	Concerns to what extent the results from research are applicable to natural social settings.

Example	Is IQ a proper measure of intelligence?	Can we be certain that x is the reason for changes in y, and not something else?	Can the findings of a research phenomenon in a case company be applicable for other companies within its industry?	Results may be technically valid, but are distinct from people's everyday lives.
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Table 6: Different types of validity (adapted from Bryman and Bell, 2007)

For survey research, one ensures replicability through describing the procedures used in the different steps of the research method. This has been followed to the letter in this section, resulting in a rather comprehensive description of the process. This is due to the many concerns the researcher has to take when conducting survey research. Reliability and validity are further taken into consideration in subsequent parts, as we have used the criteria as guidelines when designing the questionnaire, in order to obtain the highest quality possible. In the next subsection, the construction of a questionnaire is described.

2.4.2 Constructing the questionnaire

This subsection describes how we developed our questionnaire. Its main intent is to ensure measurement validity and reliability of our survey research (2.4.1). We start by presenting how indicators were employed in order to measure the important concept of purchasing sophistication. Then, we discuss how to ensure the quality of a measure employed in the questionnaire, before proceeding by presenting the types of questions that were developed, and how this was done. The importance of, and how we conducted, a pilot study is then the topic of the next paragraph. Finally, we conclude this subsection by discussing the actions taken to ensure that we followed laws and regulations when conducting the survey research.

Concepts and indicators

The notion of a *concept* is important when constructing a questionnaire. Concepts are elements of the social world which seem to have common features; they are the phenomena of which one conducts research, and the foundation for developing theory (Bryman and Bell, 2007). As a means for measuring a concept which is hard to quantify, *indicators* become essential. An indicator represents a particular concept and is used as though it was a measure of this concept (Bryman and Bell, 2007). Furthermore, when measuring a concept it is advantageous to use multiple indicators, because with a single indicator the risk of incorrectly classifying respondents is eminent. A single indicator may also measure only one aspect of the larger concept, and a last argument for using a multiple-indicator measure is that it can provide a finer classification of the respondents (Bryman and Bell, 2007).

A multiple-indicator measure can be constructed by using a *Likert scale*, either employing a five-point scale or a seven-point scale to measure each indicator of a concept. However, this type of measure is prone to a type of response bias called *response sets*, which can be defined as “irrelevant but lawful sources of variance” (Webb et al., 1966, p.19). Bryman and Bell (2007) explain that response sets occur when respondents answer consistently to a series of questions, with answers not reflecting the concept being measured. A prominent type of such response sets

are known as *acquiescence*, in which the respondents repeatedly agree or disagree with all indicators in a multiple-indicator measure. In order to sort out respondents having such a response set, an effective step is to change the description of an indicator in such a way that it reflects an opposite stance compared to the other indicators. This means that a respondent will have to reverse his or hers score on the “reversed” indicator in order to achieve the true score on the overall concept.

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The most important concept to be addressed by our questionnaire is the concept of purchasing sophistication. In order to measure this concept, we adopted a multiple-indicator measure provided to us by Associate Professor Cees Gelderman and Professor Arjan van Weele, who used it in a similar study (Gelderman and van Weele 2005). This multiple-indicator measure comprises a total of six different indicators, derived from theory, thus enabling us to measure the overall concept through several nuanced aspects (A.3; Page 12). Each indicator was presented in a five-point Likert scales ranging from strongly disagree to strongly agree. In order to identify respondents habiting a response set, more specifically acquiescence, our third indicator had an opposite stance of what reflects high purchasing sophistication compared to the other indicators.

Reliability and validity of a measure

Continuing with our previous discussion concerning the quality of quantitative research (2.4.1), it is beneficial to further elaborate on the criteria of reliability and measurement validity when designing measures to be included in a questionnaire. In relation to these two determinants of research quality, Bryman and Bell (2007) emphasize that “validity presumes reliability” (p.168), meaning that a measure of a concept cannot be valid if it is not proven to be reliable first. Bryman and Cramer (2011) explain that the reliability of a measure is a measure of consistency, and is often separated into two different main types; *internal* and *external reliability*, which are described in Table 7.

		Type of reliability	
		External	Internal
Description	Indicates to what extent a measure is stable over time		Assesses to what extent the respondent’s scores on one indicator, in a multiple-indicator measure, have a tendency to be related to scores on the other indicators. Shows to which degree the indicators are related to each other and assess the same concept (Bryman and Bell, 2007).
Measurement	Test-retest method		Split-half method or Cronbach’s alpha

Comment	There are several problems associated with the test-retest method; e.g. intervening events which can affect the results and subjects recollecting earlier answers.	As a result of the description of internal reliability, Cronbach's alpha can only be used to test variables consisting of several items (Kinnear and Gray, 2011). The rule of thumb is that the value of the Cronbach's alpha should be 0.70 or above (Nunnally, 1978).
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Table 7: Factors determining the reliability of a measure (adapted from Bryman and Cramer, 2011)

For the purpose of assessing the measurement validity of a concept, there are several different sub-categories of validity one can evaluate (Bryman and Bell, 2007; Bryman and Cramer, 2011). The types of measurement validity we have used in this master's thesis are described in Table 8 below.

	Type of validity (within measurement validity)		
	Face validity	Concurrent validity	Convergent validity
Description	Does the measure seemingly reflect the content of the concept it is measuring	Uses a criterion on which respondents are <i>known</i> to vary in relation to the concept.	The validity of a measure can be established by comparing measures developed for the same concept employing different research methods
Measurement	Expert consultation	Weak variation may suggest poor construct validity of the measure	N/A

Table 8: Different types of validity gauging the measurement validity of a concept (adapted from Bryman and Bell, 2007)

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In order to secure the quality of the questionnaire, several means were employed to ensure the reliability and validity of the measures used. Because of our limited time perspective on this master's thesis, we were unable to assess the external reliability of our measures through conducting a test-retest. However, internal reliability was evaluated in the analysis, when possible, by calculating the Cronbach's alpha. Hence, we argue that we have used all means possible in order to ensure the highest level of reliability of our measures.

In relation to our research questions, it was essential that our measure of purchasing sophistication was of the highest quality possible, implying that it displays characteristics of a valid measure. Face validity was ensured through adopting a multiple-indicator construct, devised from two international experts on the subject, together with a literature review confirming the used indicators. In addition, convergent validity was attended to through a pilot study of the questionnaire, presented later in this subsection. However, as a result of our

exploratory nature of our survey research (2.1.2), we were not able to test our measure for concurrent validity, as we knew no criterion in which the respondents are known to vary in relation to purchasing sophistication. Consequently, we argue that we have maintained a high level of validity of our most important measures.

Generating questions

Questions can be separated into two main categories; open or closed. These are somewhat complementary to each other; the advantages of a closed question correspond in many ways to the weaknesses of an open question, and vice versa. However, because of the difficulties associated with post-coding of open questions, closed questions are often preferable when designing a questionnaire (Bryman and Bell, 2007). Further, a means for limiting some of the disadvantages of closed questions is the use of an additional response category, named “other” (Bryman and Bell, 2007). In this response category, the respondents can choose to answer in a non-restricted manner if they find the provided answers unfit. Such a category can help capture interesting replies unknown to the researchers. In addition, these categories can make a closed question more comprehensive, as they allow a wide range of answers without making the list of provided answers to exhaustive (Bryman and Bell, 2007).

When designing a question, Bryman and Bell (2007) provide three rules of thumb as an important starting point: (1) Always bear in mind your research question; (2) what do you want to know; and (3) how do *you* answer it? Furthermore, in order to prevent respondents from answering questions which are not relevant for them, one can employ *filter* questions (Bryman and Bell, 2007). A filter question will guide the respondent to other relevant questions and omit those which the respondent is not capable of providing an answer to. However, Bryman and Bell (2007) explicitly state that the use of such questions requires clear instructions to the respondent. If the instructions are insufficient, there is a risk that the respondent will be given questions which he cannot answer, which may cause irritation for the respondent.

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When constructing the questionnaire, the second and third rules of thumb were consistently used as guidelines in developing questions. Throughout the process, we evaluated and ensured that the different questions were facilitating answers relevant for our overarching research question. In accordance with the recommendations given by Bryman and Bell (2007), the questionnaire consisted almost exclusively of closed questions. In addition, when the provided answers to these questions were not mutually exclusive, an additional response category named “other” was added. The main intent behind this additional response category was to capture aspects of a question which were unknown to the researchers and not captured by the provided answers. However, there are several other benefits of this measure, as mentioned above. Further, we utilized filter questions in order to extract only those questions which were relevant for the respondent, thus making the questionnaire even shorter for some respondents. As the questionnaire was made with survey software, the use of filter questions did not require any additional instructions to the respondents, as they were redirected to relevant questions in real time. As such, we prevented the case in which a respondent is given a question which he cannot

answer. Appendix A.3 provides a comprehensive overview of the questions used, their specifications and how they appeared for the respondent.

Pilot study

A pilot study is especially desirable in order to ensure that the questionnaire functions well and as intended. Bryman and Bell (2007) emphasize its importance in relation to questionnaires, as the researcher will not have the opportunity to clarify any possible questions or confusions that the respondent may have. A final purpose of conducting a pilot study is to identify if some questions are not answered, indicating that they are not understood or poorly instructed – thus implying additional adjustments (Bryman and Bell, 2007).

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As a means for enhancing measurement validity, we conducted a pilot study. In the pilot study, we distributed the questionnaire to our supervisors at NTNU and researchers at SINTEF, who were familiar with the theoretical background of our questions and thus in a position to evaluate whether our questions were suited to answer our research question. This first part of the pilot study contributed to increasing the face validity of the measures. After adjusting the questionnaire, given these evaluations, it was distributed to three MARGIN companies. These companies were selected as we possessed sufficient information about each company to evaluate if the respondents provided the “correct” answers, thus ensuring both that the questionnaire was able to capture the right information, and the measures’ convergent validity. In addition, this enabled us to evaluate if the research instrument communicated sufficient information and instruction to the respondents. Only minor changes were done to the questionnaire – mostly relating to layout and the definitions provided. We now proceed by describing actions taken in order to comply with laws and regulations concerning survey research.

Following laws and regulations

NSD is the Data Protection Official for Research for all Norwegian universities (NSD, 2012). A research project is subject to notification to NSD (i.e. obtaining a license from the Data Inspectorate) if it gathers, registers, processes or otherwise store information about individuals through questionnaires; this requirement is still valid even though the final report will not contain any personal information (NSD, 2012).

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As a consequence of asking our respondents for their company name and job title (to prevent duplication), information *could* be linked to a person through a combination of background information. Hence, we were required to subject a notification to NSD. By including a paragraph concerning personal protection in our cover letter and otherwise follow the recommended guidelines provided by NSD, we received approval to conduct our survey research. Our approval from NSD is included in Appendix A.4. In the next subsection, the distribution of a questionnaire is described.

2.4.3 Distributing the questionnaire

This subsection presents how we approached the task of distributing our questionnaire, in order to ensure the external validity of our survey research. First, the type of sampling form that we have utilized is discussed, together with a presentation of our selected sample. Then, measures to improve response rates are described, together with an overview of the measures we have employed in order to improve the response rate to the largest extent possible. Finally, we present a test for nonresponse bias, as a means for evaluating the external validity of the survey findings, and present the important measure of response rate.

Sampling

Prior to the distribution of a questionnaire, it is important to select a *sample, representative* for a larger *population*, to which you distribute the survey. A representative sample is a prerequisite in order to ensure external validity, or, in other words, being able to generalize the findings from the questionnaire to the population it is representing (Bryman and Bell, 2007). Obtaining a representative sample is extremely difficult as it is dependent on removing any *bias* it may contain. Bryman and Bell (2007) provide three sources of bias; *using a non-probability sample*, having an *inadequate sampling frame*¹ and *occurrence of non-response*.

The first source of bias can be prevented using a form of probability sampling; however, it does not prevent the other forms of biases from occurring. Bryman and Bell (2007) state that probability sampling is preferable, as it enables statistical significance test results to be generalized to its population. *Non-probability sampling* concerns all forms of sampling, other than probability sampling, and has a weaker external validity compared to the probability sampling. One type of non-probability sampling is *convenience sampling*. Bryman and Bell (2007) describe such a sample as “one that is simply available to the researcher by virtue of its accessibility” (Bryman and Bell, 2007, p.197). Such samples are prevalent in the field of business and management research; despite its inability to generalize findings, it can prove quite valuable when conducting exploratory research (Bryman and Bell, 2007). Further, Bryman and Cramer (2011) state that the difference in relative representativeness between random samples and convenience samples, is not necessary as great as implied.

Another common practice in relation to distributing a questionnaire, also covered by the non-probability sampling category, is the practice of using only one respondent to answer issues concerning the whole organization (Bryman and Bell, 2007). This practice enables more organizations to be included in the research, without incurring disproportionate amounts of increase in cost and time consumption. The size of a sample is also of importance, as sampling error decreases as the sample size increases; however, increasing the sample entails considerable cost and time consumption. These aforementioned factors create a compromise with the need for precision (Bryman and Bell, 2007).

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¹ A sampling frame is a list of all units in the population (Bryman and Bell, 2007)

² Agreeing on a classification scheme is not straight forward; Statistics Norway, the Federation of Norwegian Industries and a similar study done by Gelderman and van Weele (2005) all utilize different

In this thesis, the possibility of using probability sampling was hindered due to limited time and resources. In addition, the task of establishing a detailed sampling frame (a prerequisite for conducting probability sampling) would be extremely cumbersome, as we would have to agree on a suitable classification scheme² and then classify all Norwegian production companies according to the selected scheme. Thus, this would consume too much of our limited capacity. In addition, our questionnaire was designed to answer a research question of an exploratory, rather than explanatory, nature (2.1.2). Consequently, we found it advantageous to utilize a convenience sample. Furthermore, as we intended to uncover the procurement practices of as many Norwegian companies as possible, we used only one respondent to answer on behalf of the whole company. As this form of sampling and practice is prevalent in business and management research and is used in similar research (e.g. Carr and Pearson, 1999; Caniels and Gelderman, 2005; Gelderman and van Weele, 2005), we argue that this is not a major weakness with our survey research.

Our first convenience sample consisted of approximately 2200 members of the Norwegian Association for Purchasing and Logistics (NIMA). We found this sample suitable as these members are most likely purchasing professionals, or have a responsibility for purchasing, within their company. Thus, one can argue that these were the people most suited to answer our questionnaire concerning the purchasing practice of the company, as they assumedly possessed the best insight.

Our other convenience samples consisted of four clusters participating in the Norwegian Centres of Expertise Programme (NCE) (NCE, 2012a). They were selected as they are not necessarily members of professional purchasing organizations, nor do they necessarily have a sophisticated purchasing function; however, they still manage to grow and excel in industries subject for international competition (NCE, 2012b; c). As such, these respondents may be more representative for Norwegian production companies than the NIMA sample. The questionnaire was preferably distributed to purchasing personnel, or otherwise general managers of the NCE sample, if only such contact information was attainable. A closer description of the four clusters is provided in Table 9, together with their sample size.

Name	Description	Sample size
NCE Instrumentation (NCEI)	Located in Trøndelag, this cluster contains highly advanced expertise within the field of sensor technology and advanced control and communication solutions.	20
NCE NODE	This cluster is located at the southern coast of Norway. Member companies provide products ranging from complete oil and gas platforms to high technology equipment for drilling and production of oil and gas.	52

² Agreeing on a classification scheme is not straight forward; Statistics Norway, the Federation of Norwegian Industries and a similar study done by Gelderman and van Weele (2005) all utilize different classification schemes.

NCE Subsea	This cluster is located in the Bergen area in Norway and provides a whole range of precuts and services for the technology intensive subsea industry – serving markets for maintenance, operations and innovative technological products.	98
NCE Maritime	One of the few complete maritime clusters in the world, located in the region of Møre in the west coast of Norway. This cluster consists of world leading companies in design, development and operation of specialized offshore vessels.	96

Table 9: Description and size of each NCE cluster (adapted from NCE, 2012b).

As we have chosen to use a non-probability sampling form, lack a detailed sampling frame and are prone to the occurrence of non-response, our sample is subject for all types of bias. However, efforts were made in order to limit the occurrence of non-response bias to the greatest extent possible. These efforts, whose intent was to reduce the occurrence of non-response, coincide with the measures devised to improve the response rates of a questionnaire. These are described in the paragraph below.

Improving response rates

A prevalent weakness of a questionnaire is lower response rates compared to an interview-based instrument (Bryman and Bell, 2007). This will increase the probability of the findings being biased, thus weakening the external validity of the research. However, several measures to improve the response rates of a questionnaire are developed; some of these are mentioned in Table 10.

Measure	Description
Cover letter	A cover letter will accompany the request to conduct the questionnaire. This letter will explain to the respondent the rationale behind doing the research and its importance. Further, it provides guarantees of confidentiality as well as mentioning any sponsors or collaboration partners.
Follow up	It is important to follow up on non-respondents in the selected sample. Sending out reminders, e.g. every two weeks, have shown to have a positive effect on the response rate.
Keep it short	Bryman and Bell (2007) emphasize that shorter questionnaires will provide an improved response rate compared to longer ones, as it minimizes the risk of what they define as “respondent fatigue”. However, the distinction between a short and a long questionnaire is quite arbitrary, and if the topic is of interest to the respondent, he/she can be very persevering.

Layout	A questionnaire should be easy for the respondent to follow and complete. One should provide instructions and explanations whenever it may seem appropriate. In addition, the layout should be given some considerations, e.g. making adjustments in order for the questionnaire to appear less bulky.
Order of questions	As a means of removing any doubt of why the respondent has been selected to conduct the questionnaire, questions related to the research phenomenon should come early. Further, questions that are likely to be important for the respondent should also be of the first questions asked, in order to capture their interest.
Closed questions	When encouraging potential respondents to take a questionnaire, the instrument should have as many closed questions as possible. The reason for this is because respondents often get discouraged of having to write many of their answers. In addition, closed questions are less time consuming and easier to answer.

Table 10: Measures to improve response rates of a questionnaire (Adapted from Bryman and Bell, 2007).

Several of these measures are a consequence of the lack of an interviewer who can answer questions that the respondent may have. This is also the main characteristic separating a questionnaire from a structured interview, which is the other main instrument for gathering data when doing cross-sectional design (Bryman and Bell, 2007).

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In accordance with the guidelines to improve response rates, we formulated a cover letter. In addition to the recommendations by Bryman and Bell (2007) (Table 10), the cover letter explicitly stated how many questions the questionnaire contained, as well as the projected time consumption. This was done in an attempt to convince as many as possible to share a few minutes of their time to answer the questionnaire. Several reminders were sent to the NCE samples, in order to increase response rates. Our intention was to distribute a reminder to the NIMA sample as well; however, NIMA did not allow this. Considerable efforts were made in order to keep the questionnaire as short as possible, without compromising its ability to answer our research questions. The final edition of the questionnaire therefore consisted of only 15 questions, where just three questions were open-ended. Furthermore, the questionnaire was made accessible through its own URL-address, enabling potential respondents to conduct the questionnaire at a time and place of their choice.

The questionnaire was created and designed in the SelectSurvey software. This software enabled us to use customized templates designed for NTNU, creating a professional presentation of the questions to the respondents³. The questionnaire consistently provided explanations of less intuitive concepts. As mentioned previously, we utilized filter questions in order to avoid situations where respondents were unable to answer (an) irrelevant question(s). However, few of the provided recommendations in relation to the order of questions in the questionnaire, were used. Arguably, this was not a problem, due to the few questions employed. A last measure in

³ According to Fox et al. (1988), studies sponsored by a university receive higher response rates.

order to encourage as many respondents as possible to conduct the questionnaire, was to award those who completed the questionnaire with a pamphlet containing the main findings from the questionnaire. The questionnaire itself is provided in appendix A.3.

Nonresponse bias test and response rates

If respondents differ considerably from nonrespondents, one cannot say directly how the whole sample would have responded – a considerable threat for the external validity of the survey research (Armstrong and Overton, 1977). Armstrong and Overton (1977) provide an extrapolation method for estimating nonresponse bias, which is based on the assumption that late respondents are more like nonrespondents. The method classifies early and late respondents of the questionnaire in distinct groups, which are then compared on relevant variables in order to establish the presence of nonresponse bias (Gelderman and van Weele, 2005).

Response rate is a measure indicating how carefully a survey study is constructed (Frohlich, 2002). With a higher response rate, the sample increases; as such, the need to follow up potential respondents and the concern for non-response bias is reduced (Fox et al., 1988). Frohlich (2002) states that with a low response rate there is a danger that the few received respondents are the more prosperous companies. It is difficult to agree on what is an acceptable response rate, however, Frohlich (2002) find that the average response rate is about 32%.

The results from our test for nonresponse bias and discussion of response rates are provided in chapter 6, which provides the results from our survey research. We now proceed by providing an overview over the methods used in our analysis.

2.4.4 Analysis of survey data

This subsection provides a presentation of the methods most frequently used for analyzing our survey data. First, we present the different categories a variable may be classified as. Next, we describe the most important methods used in our bivariate analysis. Finally, we present the concept of factor analysis, as this analysis was used to derive some important findings.

Providing a description of all the available methods for survey data analysis and their underlying assumptions is not the intention of this chapter. Consequently, some of the methods utilized are regarded known to the reader; else, the reader is referred to relevant literature for further elaboration where this is regarded orderly.

Type of variable

A variable, in addition to being either dependent or independent – where the latter affects the former – can be categorized as one of four main types (Bryman and Bell, 2007). These are provided in Table 11 below.

Type of variable	Description	Example
Interval/ratio variables	Variables where the distances between the categories are identical across the range. A distinction between interval and ratio variables is that the latter are interval variables with a fixed zero point.	Company's turnover and cost of goods sold
Ordinal variables	Variables whose categories can be rank ordered, but the distances between the categories are not equal across the range	Number of employees and use of purchasing portfolio analysis
Nominal variables	Variables whose categories cannot be rank ordered; also known as categorical	Type of production situation
Dichotomous variables	Variables containing data that have only two categories. Is usually considered as a nominal variable (Bryman and Cramer, 2011).	Existence of a dedicated purchasing department

Table 11: Main types of variables (adapted from Bryman and Bell, 2007).

These variables determine appropriate methods for analysis. In the next paragraph, we describe bivariate analysis.

Bivariate analysis

An analysis of the connection between two variables is termed a *bivariate analysis* (Bryman and Cramer, 2011; Tabachnick and Fidell, 2001), and may be separated between two types of use (Bryman and Cramer, 2011). *First*, bivariate analysis can analyze whether there is a statistical significant difference between scores on the two variables. *Second*, a bivariate analysis may investigate if there is a statistical significant relationship between the two variables. The methods of analysis which one can utilize, both for investigating the difference and relationship between the variables, are dependent upon the type of variables being analyzed (Bryman and Cramer, 2011).

In our analysis of the survey data (chapter 6), most of the investigation of difference between variables utilized a *t-test*, which investigates the difference of two unrelated means. In order to use such a test, the dependent variable, or *criterion variable*, (in this study, the purchasing sophistication) must be non-categorical, and the independent variable (*the comparison variable*) must comprise of values that are unrelated (Bryman and Cramer, 2011). For example, the group of ETO and non-ETO companies is unrelated. In addition, a t-test is a parametric test, which must fulfill the following requirements (Bryman and Cramer, 2011); (1) the level or scale of measurement is of equal interval or ratio scaling, (2) the distribution of the population scores is normal, and finally (3) the variances of both variables are equal or homogeneous. In relation to the second criteria, it is worth noting that “if we draw samples from a population of values that is normally distributed, then the means of those samples will also be normally distributed” (Bryman and Cramer, 2011, p.172).

Bryman and Bell (2007) provide methods for exploring relationships between variables, dependent on the two variables involved; these are presented in Table 12 below.

	Nominal	Ordinal	Interval/ratio	Dichotomous
Nominal	Contingency table, chi-square(χ^2) and Cramér's V	Contingency table, chi-square(χ^2) and Cramér's V	Contingency table, chi-square(χ^2) and Cramér's V If the interval/ratio variable can be identified as the dependent variable, compare means + eta.	Contingency table, chi-square(χ^2) and Cramér's V
Ordinal	Contingency table, chi-square(χ^2) and Cramér's V	Spearman's rho (ρ)	Spearman's rho (ρ)	Spearman's rho (ρ)
Interval/ratio	Contingency table, chi-square(χ^2) and Cramér's V If the interval/ratio variable can be identified as the dependent variable, compare means + eta.	Spearman's rho (ρ)	Pearson's r	Spearman's rho (ρ)
Dichotomous	Contingency table, chi-square(χ^2) and Cramér's V	Spearman's rho (ρ)	Spearman's rho (ρ)	Phi (ϕ)

Table 12: Methods of bivariate analysis (Bryman and Bell, 2007, p.360)

As there are more methods available for conducting bivariate analysis, than described in this master's thesis, we refer to the books by Bryman and Cramer (2011) or Kinnear and Gray (2011) for additional information.

Factor analysis

Factor analysis is a method for analyzing a multiple-indicator measure of a concept. Interrelated indicators of a concept constitute a *factor*; thus, factor analysis is a term for statistical techniques which help determine these factors (Bryman and Cramer, 2009). Bryman and Cramer (2009) explain that factor analysis serves two main purposes. *First*, such an analysis can be used to assess to which degree different indicators measure the same concept. The *second* purpose of conducting a factor analysis is that it can reduce the number of indicators measuring a concept. Further, a factor analysis is often of an *exploratory* nature, where the relationship between variables is investigated without having a hypothetical preconception of the relationship (Bryman and Cramer, 2009).

In this master's thesis we will not elaborate any further on the calculations behind conducting such an exploratory factor analysis. The reader is referred to the book by Bryman and Cramer, (2009) or Tabachnick and Fidell (2001) for a more elaborate explanation of this topic. Next, we present some critique of survey research.

2.4.5 Critique on survey research

Quantitative research has been a victim of some critique, especially from supporters of qualitative research (Bryman and Bell, 2007). Bryman and Bell (2007) provide a short description of the most prevalent critique; this is summarized in Table 13.

Critique	Description
The measurement process possesses an artificial and spurious sense of precision and accuracy	The measures developed and the concepts they are supposed to reveal are assumed rather than real. In addition, it is presumed that respondents interpret the key terms in a question similarly, which is faulty according to critics.
The reliance on instruments and procedures hinder the connection between research and everyday life	How can we be certain that a respondent possesses the required knowledge to answer a question? Are all the respondents in agreement of the importance of the investigated topic in their everyday life?
The analysis of relationships between variables creates a static view of social life that is independent of people's lives	How can we be certain that a relationship between two or more variables has not been produced by the individuals to whom it applies?

Table 13: Criticisms of quantitative research (adapted from Bryman and Bell, 2007)

Survey research and causality

According to Bryman and Cramer (2011), establishing causality between variable is one of the major concerns among quantitative researchers. The authors proceed by explaining that in order for there to be a causal relationship, several criteria's must be met. *First*, there must be an established relationship between the variables. *Second*, the relationship must not be spurious, i.e. there must be a "true" relationship between the two variables, not including any influence from a common variable. *Third*, the cause must precede the effect, the time order of the variables in question must be established. However, survey research has a limited capacity in establishing causal relationships (Bryman and Cramer, 2011). The authors proceed by explaining that when doing survey research, data is collected simultaneously; consequently, it is impossible to establish the time order of the variables. Further, as variables are not capable of being manipulated (e.g. company size) the researcher has a limited ability to assign cause and effect (Bryman and Cramer, 2011). Hence, it is apparent that the last criterion for establishing a causal relationship between variables is extremely difficult to achieve with survey research. Bryman and Cramer (2011) state that "survey designs are often called correlation designs to denote the tendency for such research to be able to reveal relationships between variables and to draw attention to their limited capacity in connection with the elucidation of causal relationships" (p.15). Next, an evaluation of the survey research is provided.

2.4.6 Evaluating the survey research

We now conclude the section concerning survey research by evaluating the survey research process in relation to the three criteria for ensuring quality of quantitative research; replicability,

reliability and validity (2.4.1). A discussion of each criterion is presented. Finally, a conclusion with an assessment of the overall quality of this survey research is provided.

Replicability

In order to achieve a high level of replicability of our survey research, we have thoroughly presented our research process or otherwise referred to relevant literature for a further elaboration on the topic. An appendix containing the questionnaire is also included in this master's thesis (A.3), to further facilitate the replicability of this survey research. Hence, we argue that we have achieved a high level of replicability.

Reliability

This criterion of quantitative research quality examines whether a measure of a concept is stable, and, as such, the ability of repeating the results from the study (2.4.1). When examining the reliability of a measure, we were unable to evaluate the external reliability because of our limited time perspective (2.4.2). However, the internal validity was assessed by calculating the Cronbach's alpha. Hence, we argue that we have initiated all means possible to achieve a high as possible reliability of this survey research.

Validity

Validity is the most important determinant of qualitative research quality. It assesses the integrity of the generated conclusions from the research (2.4.1). As a means for enhancing the overall validity of our survey research, we started by ensuring *measurement validity* through the underlying face -, concurrent - and convergent validity. Face validity of the measures employed was enhanced through our pilot study. In addition, we adopted a multiple-indicator construct from a similar study by two recognized researchers within this field of research, in order to measure purchasing sophistication. Concurrent validity was sought through a pilot study, distributing the questionnaire to three companies in which we possessed enough information to evaluate the answers. However, we did not receive the answers from these companies, before the agreed distribution date with NIMA and NCEI. Nevertheless, as a consequence of the questionnaire being thoroughly prepared, there was no need to make any adjustments to the questionnaire once we had received the answers from our collaborating companies. Convergent validity was enhanced for the measure of purchasing sophistication, as our literature review (chapter 4) converged on the same indicators as those adopted by Gelderman and van Weele (2005).

A recognized weakness of survey research is that it is extremely hard to establish a causal relationship (2.4.5); hence, survey research is prone for having a weak *internal validity*. As we have established several significant relationships in our survey analysis, it is of further research (employing other research methods) to establish that cause precedes effect in these relationships, and, as such, be able to establish causality between the variables.

External validity is mainly attended to through a careful distribution of the questionnaire. Our sample is prone to all three sources of bias in relation to obtaining a representative sample (2.4.3). The first and the second types of bias (non-probability sampling and inadequate sampling frame, respectively) are related; a sampling frame is necessary in order to conduct probability sampling. For reasons mentioned earlier (primarily limited resources and time), we

were not able to establish a sampling frame; thus, we could not conduct a probability sampling form. However, the use of convenience sampling is prevalent in similar research, and the relative representativeness between random samples and convenience samples, is not necessary as great as implied (2.4.3). Consequently, we argue that this is not a major weakness with our survey research. We do, however, have to be cautious when generalizing our survey findings, due to the lack of a sampling frame. The last type of bias (nonresponse) received considerable attention, in the form of increasing response rate, and guidelines were followed to the letter. However, we were not able to issue a reminder to the NIMA sample, as the association would not allow this. For the NCE samples, where we contacted each company individually, a reminder considerably increased our response rates⁴. Hence, we argue that the NIMA sample could have been considerably larger if a reminder was distributed. In addition, we promised a pamphlet to the respondents as a reward for answering the questionnaire. We are convinced that this improved our response rates and reduced the occurrence of non-response bias.

Ecological validity has received little attention when conducting our survey research, mostly because it is a less prevalent type of validity. However, we argue that our mixed methods approach in this master's thesis have ensured a strong ecological validity, as our action research has a strong foundation in the social setting, thus contributing to making the findings applicable to a social setting. Next, we provide an overall evaluation of the quality of survey research.

Overall quality of the survey research

From our previous discussion it is evident that we have ensured a high level of replicability and as high level of reliability as possible for our survey research. In relation to validity, several measures were employed in order to enhance the measurement validity, which secured the validity of our most important measures. The external validity of our survey research was weakened by a lack of a sampling frame. This prevented us from using a form of probability sampling. However, several precautions were taken in order to decrease the occurrence of non-response bias, thus improving the external validity of our results. Ecological validity was attended to by applying a mixed methods approach. In conclusion, we argue that a thorough survey research process has ensured a high quality of our survey research, even though we have a somewhat weaker external validity. Through using quality measures of quantitative research as guidelines for doing survey research, we argue that we have conducted the research in a best possible way. In the next section, we briefly describe the process of conducting literature reviews.

2.5 Literature reviews

According to Walliman and Buckler (2008), a literature review outlines the theoretical aspects and previous research of an investigated phenomenon. As such, it is an important method for developing a theoretical framework (Dubois and Gadde, 2002). Hart (2001) follows in the same line of argument, as he emphasizes the importance of doing a literature research in order to become completely familiar with the investigated phenomenon. "A thorough critical evaluation

⁴ We did not send a reminder to the NCEI sample as we achieved a satisfactory response rate immediately after distributing the survey.

of existing research often leads to new insights by synthesizing previous unconnected ideas, ... and suggest solutions tried in similar situations” (Hart, 2001, p.2). A literature review may also reveal how other authors have approached your researched phenomenon and how they were able to collect the relevant data (Hart, 2001; Yin, 2009). As such, an important prerequisite in preparation for most types of research is the execution of (a) literature review(s) (Yin, 2009).

Executing the literature reviews

We found it best to conduct literature reviews in order to get an understanding of the phenomena we were investigating, in addition to ensuring that our research could contribute to expanding the knowledge on the related research areas; avoiding redundant reproduction of previously performed research. The first step of our literature review consisted of establishing two sets of search words to use when searching for literature in electronic databases. The category 1 search words were considered the most relevant, and could be used alone or in conjunction with the category 2 search words. The category 2 search words served to further narrow and refine a search. The search words developed for the literature reviews on ETO, purchasing portfolio approaches and purchasing sophistication are displayed in Table 14⁵.

Topic	Category 1	Category 2
Engineer-to-order	Engineer-to-order; ETO; Design-to-order; Build-to-order; Make-to-stock; Non-make-to-stock; One-of-a-kind; Project	Supply; Procurement; Purchasing; Logistics; Upstream; Strategy; Structure; Supply Chain; Decoupling Point; SME/Small Medium; Enterprise; Customization; Lead Time
Purchasing portfolio approaches	Portfolio model(s); Supplier segmentation models; Portfolio of relationships; Purchasing models	Purchasing; Sourcing; Procurement; Supply Chain
Purchasing sophistication	Purchasing sophistication; Purchasing maturity; Purchasing skills; Purchasing professionalism	<i>None</i> ⁶

Table 14: Search words utilized in the literature search

After establishing the search words, we then proceeded by doing searches in the following electronic databases: Google Scholar; ProQuest; ISI Web of Knowledge; Emerald; Science Direct; SpringerLink; and, Scopus. The journal papers, books and other documents discovered through these searches were then judged to be relevant or not, by reading their abstract.

Relevant papers were then stored in an online database and, information about the papers (e.g. title; authors; year; abstract; topic; methodology) was stored in a ‘literature review worksheet’. This functioned as a work of reference, and helped categorizing the literature. Criteria for including the papers in this work sheet were that they had to make a contribution to answer the research questions. Furthermore, as our research has a strategic focus, papers which had an operational or tactical level in their discussion were given a lower priority level. For

⁵ The literature reviews on ETO and purchasing portfolio approaches were conducted first time fall 2011. However, these reviews have been supplemented with new literature during spring 2012.

⁶ We did not see the need for a second category of search words concerning purchasing sophistication, as a search for ‘purchasing’ as category 1 would have led to a vast amount of literature unrelated to the thesis.

papers in which we were uncertain about their relative quality, we utilized the Association of Business Schools' (ABS) "Academic Journal Quality Guide" to help us determine its quality. In the next section, some concluding remarks on methodology are presented.

2.6 Concluding remarks on methodology

In conclusion, we feel that a conscious attitude to methodology throughout our research process has been very beneficial, and that the methodology used has been solid. Through investigating how we could approach our research questions, and spend the sufficient amount of time in planning the chosen methods, we avoided common pitfalls and increased our effectiveness throughout the research process. As seen from the aforementioned tests on research quality, both in relation to the action research (2.3.5) and survey research (2.4.6) we have consciously taken actions to secure the quality of the research. The mixed method research strategy has strengthened both research methods used in this master's thesis, by facilitating versatile angles to the overall research problem in taking both a micro- and macro perspective. We feel that we, to the limit of our capacity, have conducted research of a high quality. This increases the value for other researchers wanting to check, or build upon, our findings.

Part I: Theoretical foundation

In this part, each of the topics constituting the ternary relationship depicted in our conceptual framework (1.2; Figure 9) is investigated in depth. As mentioned in 2.1.3, this is done in order to partly answer the first research question; “what are important features of purchasing portfolio approaches, purchasing sophistication and engineer-to-order?” These topics are, as illustrated in Figure 16, presented in chapter 3, 4 and 5, respectively.

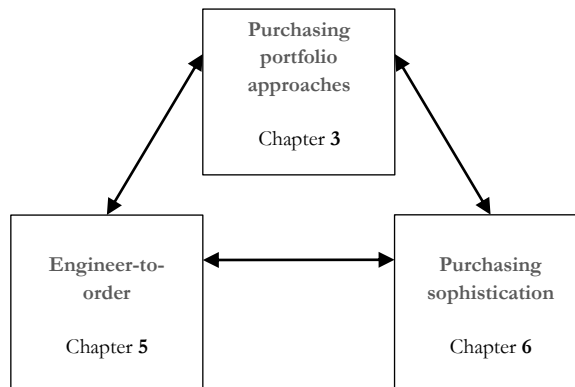


Figure 16: Topics treated in Part I

Each chapter is concluded with findings that are brought along to the establishment of a theoretical framework at the end of this part. This theoretical framework itself partly answers the first research question of this master’s thesis. This framework will be further refined, with empirical findings, to fully conclude RQ1. This is done in chapter 8. The refined framework is used in subsequent analyses (chapter 9-11), where RQ2-4 are answered (1.2; Figure 9).

3 Purchasing portfolio approaches

The purpose of this chapter is to gain a fundamental understanding of purchasing portfolio approaches. First, definitions of central terms, and the context of purchasing portfolio approaches, are given. We then discuss an increase in popularity of these approaches following the strategic recognition of the purchasing function, before elaborating on the identified purposes of using a purchasing portfolio approach. We proceed by describing the most influential purchasing portfolio approach in detail, for then to provide a thorough comparison of the most prevalent approaches. When utilizing a purchasing portfolio approach, it is important to consider its given critique; thus the following section is devoted to describing this critique. The concepts of power and dependence are then presented, as they comprise a fundamental assumption behind purchasing portfolio approaches, and are important for understanding buyer-supplier relationships. Finally, we summarize the findings that will be brought along to the theoretical framework.

3.1.1 Definitions and context

As means for avoiding confusion and establishing a common understanding, the following important terms are defined; *portfolio*, *portfolio model* and *portfolio approach*. We utilize definitions by Gelderman (2003), whose doctoral thesis concerned portfolio approaches; thus possessing a comprehensive understanding of the subject. According to Gelderman (2003), a *portfolio* is “a collection of different items, objects or subjects that are connected to each other” (p.21). A *portfolio model* is “a tool that combines two or more dimensions into a set of heterogeneous categories for which different (strategic) recommendations are provided” (Gelderman, 2003, p.21). Gelderman (2003) provides no explicit definition of a *portfolio approach*; however, he states that in business administration, “a portfolio approach is a way of looking at and dealing with (management) problems by focusing on a small number of important factors” (p.21). From this, and based on our understanding of several prevalent portfolio approaches, we wish to specify that a portfolio model may be a tool to use *within* a portfolio approach. The overall portfolio approach may contain other tools or measures for solving complex management problems, in addition to a portfolio model.

Referring to the strategic roles of the purchasing function (discussed in the introduction, 1.1.5), we displayed the relationship between core purchasing processes (Figure 4). Among these, the use of purchasing matrices and approaches lies within the process of category strategy development (Monczka et al., 2011). When elaborating on the process of developing a category strategy, Monczka et al. (2011) emphasize the importance of aligning these strategies with supply management strategies, as well as business unit and corporate strategies.

Figure 17 depicts this alignment, together with a closer definition of the different strategies.

Level 1	Corporate strategies	Concerned with the definition of businesses in which the corporation wishes to participate and the acquisition and allocation of resources to these business units.
	↓	
Level 2	Business unit strategies	Concerned with the scope or boundaries of each business and the links with corporate strategy and the basis on which the business unit will achieve and maintain a competitive advantage in the industry.
	↓	
Level 3	Supply management strategies	These (functional) strategies specify how supply management will support the desired competitive business-level strategy and complement other functional strategies.
	↓	
Level 4	Commodity/category strategies	<i>Definition provided below</i>

Figure 17: Alignment of strategies on four levels (inspired by Monczka, 2011)

This strategy alignment is essential for enabling the purchasing function to make a contribution to the overall corporate strategy (Monczka et al., 2011; Beckman and Rosenfield, 2008; 1.1.4). Further, in order to ensure that activities and resource allocations at lower levels are consistent with high-level strategic goals, an alignment of the strategies is essential (Cousins et al, 2008).

When a company has made the decision to procure a product or service, they are in need of a *category strategy* (Monczka et al., 2011). A category is, according to Monczka et al. (2011), a “specific family of products or services that are used in delivering value to the end user” (p.191). A category strategy is a decision process used to identify which suppliers to choose, which form of contract to use, which performance measures to utilize and what contractual arrangements to negotiate (Monczka et al, 2011). Such a strategy is created through a strategic sourcing process, depicted in Figure 18. The terms category strategy and *sourcing strategy* are often used interchangeably, as a sourcing strategy most often concerns a category of products or services (van Weele, 2010; Monczka et al., 2011).

From Figure 18 below we see that portfolio matrices (and approaches) are used within the third step of the strategic sourcing process. Monczka et al. (2011) recommend using a portfolio matrix as a tool for structuring the information gathered from the previous steps in the process, in order to make an optimal decision. A portfolio analysis provides a segmentation of the supply base and a recommended strategy for each product or category of products (Monczka et al., 2011). After utilizing a portfolio matrix (or approach), the team proceeds by narrowing down potential suppliers through evaluating their capabilities. Those suppliers who best fit the category strategy to be employed are then selected, concluding this third step of the process (Monczka et al., 2011). Now that we know how one utilizes a purchasing portfolio approach within the purchasing function, we will proceed by presenting the prevalence of portfolio models in different fields.

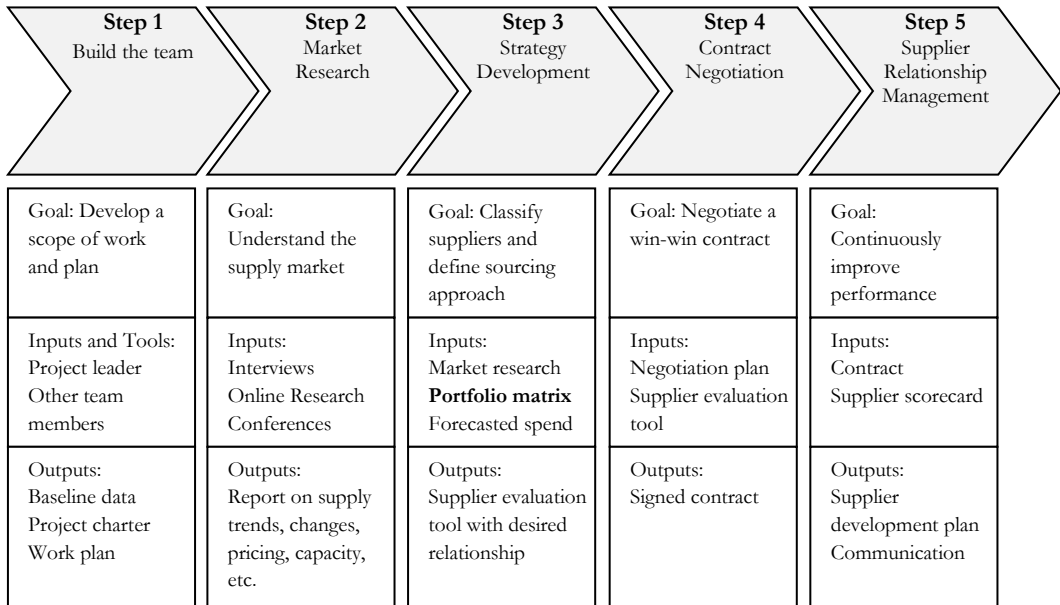


Figure 18: Strategic Sourcing Process (Monczka et al., 2011)

3.2 The use of portfolio models within different fields

While the use of portfolio models has a wide range of applications, such as in relation to equity investments, product portfolio models and management of customer relationships (Turnbull, 1990), the use has been most evident in the area of strategic planning, with pioneers such as Michael Porter recommending the use of such models when analyzing suppliers, buyers and competitors (Olsen and Ellram, 1997; Porter, 1985). Within this field, the models most used are those for management of strategic business units within a company (Turnbull, 1990), where the best known models are the Boston Consulting Group (BCG) matrix (Hedley, 1977) and the General Electric (GE) business screen (Hofer and Schendel, 1978; referred to in de Wit and Meyer, 2010).

According to Olsen and Ellram (1997), models made for marketing and purchasing have received little attention compared to models within strategic planning. They further connect the disciplines of marketing and purchasing when building on the argument that “marketing and purchasing are essentially mirror images, and the models suggested in marketing can therefore provide the basis for development of models in purchasing” (p.102). In their literature review on portfolio models, Olsen and Ellram (1997) list a summary of all articles describing the use of portfolio models in marketing and purchasing up until the year the paper was written (1997), which only counts six. Compared to the extensive work in the field of strategic planning, this finding can be argued to be in line with Turnbull (1990): “The relatively few models designed for the management of purchasing functions bear testimony to the neglect in this strategic area” (p.21).

3.2.1 The development of purchasing portfolio approaches

Turnbull made his statements on the strategic neglect of purchasing in 1990, but since then, the field of purchasing has grown into what we today would call a *strategic function* (Cousins et al., 2008) and *contributor to competitive advantage* (Mol, 2003) (1.1.4). Alongside this development, the usage and development of new purchasing portfolio approaches has also been increasing (e.g. Lilliecreutz and Ydreskog, 1999; Gelderman and van Weele, 2005; Caniëls and Gelderman, 2007; Day et al., 2010). Portfolio approaches have been expanded to incorporate concerns for areas such as supplier involvement in new product development (Wynstra and Pierick, 2000), e-purchasing (Croom, 2000), the specification process (Nellore and Söderquist, 2000), and sourcing in the global context (Trautmann et al., 2009; Gelderman and Semeijn, 2006). A recent trend of sustainable sourcing has spawned new portfolio approaches incorporating an environmental concern (Cousins et al, 2008; Pagell et al, 2010).

3.3 Purposes of using a purchasing portfolio approach

We have now elaborated on the context in which a purchasing portfolio approach is utilized and its development. In this section, a presentation of the main identified purposes of using a purchasing portfolio approach is provided. First, the most commonly cited purposes are presented. Concluding this section, is a presentation of the importance, characteristics and a company's capacity of handling supplier relationships, and its relation to the purposes of using a purchasing portfolio approach.

3.3.1 Main purposes of using a purchasing portfolio approach

Turnbull (1990) states that management decisions are interrelated, and argues that portfolio analysis and planning considers this, as it provides an integrated approach to the management of different aspects of business. Another application is to help optimize the use of a company's limited resources over its different supplier relationships (Wind and Mahajan, 1981; Turnbull, 1990; Pagell et al., 2010). Olsen and Ellram (1997) suggest that a portfolio model should be used as an analytical tool to organize information, and develop a classification framework for the items being analyzed. This ability of a purchasing portfolio approach, breaking down complex problems into their most important dimensions, has made it one of the most important tools available to purchasing (Syson, 1992; referred to in Trautmann et al, 2009).

According to Nellore and Söderquist (2000), the purpose of using portfolio models is to “optimize the use of capabilities of different suppliers” (p.263). Gelderman and van Weele (2002) discover, through a case study of a major Dutch chemical company, that the use of Kraljic's purchasing portfolio approach “seems to be an effective tool for discussing, visualizing and illustrating the possibilities for differentiated purchasing and supplier strategies” (p.35). This is also recognized by Smart and Dudas (2007), who explain that it is the simplicity of a portfolio matrix and the facilitation of communication that makes it attractive for practitioners. Day et al. (2010) state that the actual output of a segmentation model (defined in similar terms and used interchangeably with purchasing portfolio model) is an assessment of the supply base as well as a contribution to the decision making on relational investments – investments made for gaining competitive advantages through collaboration. In the long term, purchasing portfolio models can be used to study the progress of a relationship over time, and support strategic decision

making on products and markets (Day et al., 2010). Several authors (e.g. Olsen and Ellram, 1997; Trautmann et al, 2009) emphasize that the process of categorizing the purchases in a portfolio model may be even more important than the resulting classification; the reason being that the process forces key decision makers in the company to discuss and agree on the importance of different products, suppliers, or relationships which are categorized in the model.

Portfolio models may further be a means for cross-functional coordination. Gelderman and Semeijn (2006) discovered, through an in-depth case study of a chemical company, that the portfolio model adopted by the company's purchasing functions forced cross-functional teamwork within each business unit, and as such improved their internal coordination. Gelderman and van Weele (2005) also emphasize that adopting portfolio models within cross-functional teams gives non-purchasing specialists a practical framework for analyzing and discussing purchasing issues.

Dubois and Pedersen (2002) provide a summary of the intentions of the purchasing portfolio approach, suggesting that the popularity of the purchasing portfolio model can be accredited to two of its characteristics: *First*, it provides practical guidelines for managing different purchasing situations and supplier relationships. *Second*, the models are relatively easy to understand and communicate to other members of the organization.

3.3.2 Management of supplier relationships

Several authors have commented on the importance and characteristics of supplier relationships. According to Gadde and Snehota (2000), "the most critical element of supply strategy is a company's capacity to handle various types of supplier relationships" (p.306). Cousins et al. (2008) claim that the management of relationships will vary according to both the strategy of the organization and the product sourced; and, as such, "the type of business outcome will dictate the level of relationship process or detail of course of action required to achieve it" (p.179). According to Håkansson and Snehota (1995), business relationships generally have structural characteristics in terms of continuity, complexity, symmetry and informality, and process characteristics in terms of adaptations, cooperation and conflict, social interaction and routinization. Following the argument by Cousins et al. (2008), the content within each characteristic will vary depending on the business outcome. Watts et al. (1995) emphasize that purchasing links suppliers to the company; in order to incorporate these suppliers' capabilities in the strategic planning process of a company, the supplier relationships must be properly managed.

A discussion about the need and capacity for handling supplier relationships is prevalent in the literature. Gadde and Snehota (2000) claim that companies need both high and low involvement relationships, due to the fact that different degrees of involvement lead to different costs and benefits, and that the resources that can be dedicated to the management of supplier relationships are limited. The latter is also recognized by Cousins et al. (2008), who claim that the cost of the resources will escalate depending of the complexity of the relationship output. Lilliecreutz and Ydreskog (1999) state that an efficient purchasing strategy will not treat every supplier relationship in the same way. The best utilization of suppliers requires that resources are

allocated to relationships in proportion to expected potential outcomes of the relationships (Gadde and Snehota, 2000). As previously mentioned, purchasing portfolio approaches can be used as a tool for managing supplier relationships (Nellore and Söderquist, 2000; Dubois and Pedersen, 2002). Turnbull (1990) recognizes that purchasing portfolio approaches may help to ensure differentiated supplier relationships and optimize the use of a company's limited resources.

Another argument favoring the use of portfolio approaches to manage supplier relationships is provided through the International Marketing and Purchasing (IMP) Group's Interaction Approach to the study of buyer-seller relationships. The IMP group moves away from the traditional view of the buyer being a passive partner – and shows that both the buyer and supplier are interested in partnerships to reap benefits from each other's resources and capabilities (Turnbull, 1990). Interdependency is formed in the relationship, making the two parts adapt to each other. As a company regards the individual suppliers or customers of different importance, the approach of portfolio planning thus seems fit to managing both suppliers and customers (Turnbull, 1990).

3.4 Purchasing portfolio approaches

In this section, we will elaborate on some of the most well-known purchasing portfolio approaches. First, the approach by Kraljic (1983) is presented, in order to provide the reader with a fundamental understanding of the concept of purchasing portfolio approaches. Thereafter, the most prevalent amongst the portfolio approaches exercised in practice (Gelderman and Van Weele, 2002; 2005; Lamming and Harrison, 2001), are presented. Finally, a summarization of important characteristics and comparisons of the most prevalent purchasing portfolio approaches are given.

3.4.1 Kraljic's purchasing portfolio approach

Kraljic (1983) introduced the first purchasing portfolio approach in an effort to make purchasing adapt to current environmental and economic changes, and move from purchasing operations to (strategic) supply management. This portfolio approach has later been recognized as a major breakthrough in the development of professional purchasing (Gelderman and van Weele, 2003) and initiated a stream of both empirical and conceptual research in relation to the use of such approaches in purchasing (Kibbeling et al., 2009).

Kraljic (1983) acknowledged that the need for a supply strategy is dependent upon the unique characteristics of the individual company, and by determining *the strategic importance of the purchase* (in terms of their value added, impact on profitability and other factors) and *the complexity of the supply market* (in terms of supply scarcity and pace of technology development, and other factors), the required purchasing sophistication can be determined in terms of four management dimensions. These dimensions are further utilized in the purchasing portfolio approach, and are illustrated in Figure 19 below.

The purchasing portfolio approach by Kraljic (1983) consists of four phases, where the first phase involves classifying the sourced materials or components in what is later known as the

Kraljic matrix. After having categorized all of the sourced items, the company’s top management would then, according to Kraljic (1983), determine an appropriate supply strategy which enables the company to “exploit its purchasing power vis-à-vis important suppliers and to reduce its risks to an acceptable minimum” (p.110). We will now proceed by a closer investigation of each of the four phases.

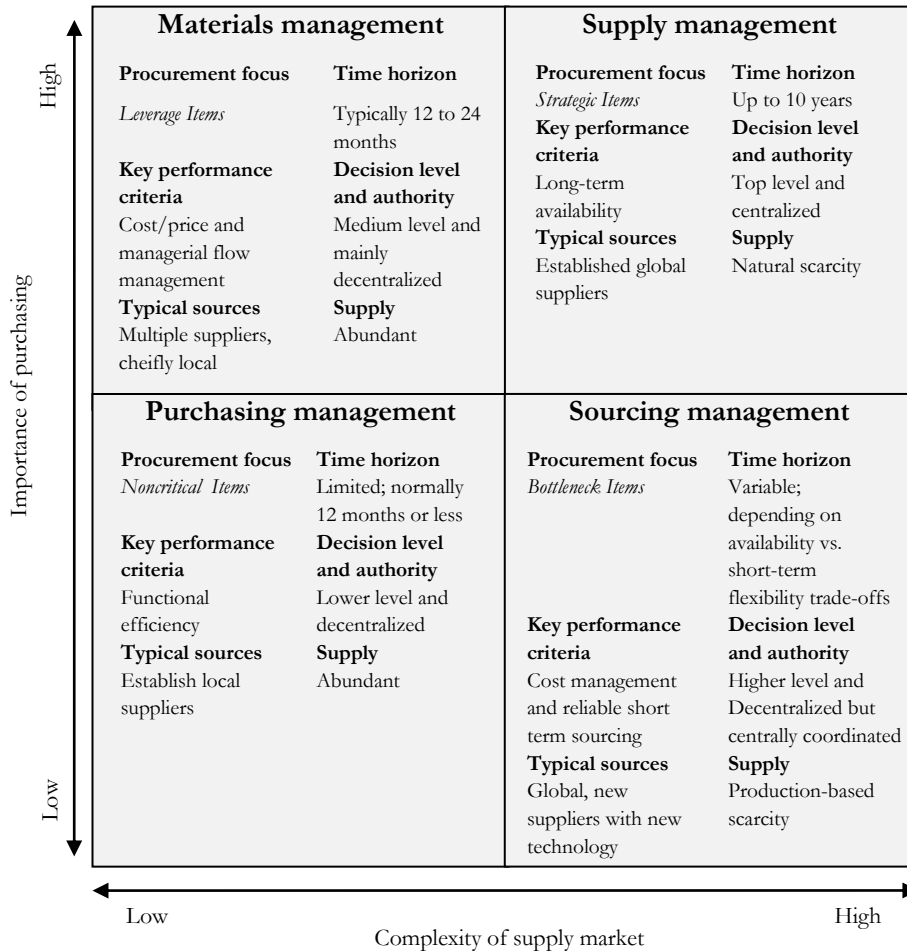


Figure 19: Stages of Purchasing Sophistication (Kraljic, 1983, p.111)

The **first phase** consists of using the two different criteria, *profit impact* and *supply risk*, to categorize every sourced item in one of four different categories, as shown in Figure 20. Kraljic (1983) defines profit impact in terms of percentage of total purchasing cost, volume purchased, impact on product quality and business growth. As such, the profit impact considers the strategic importance of the purchase. The next criteria have a market focus, assessing the complexity of the supply market. Supply risk is determined by evaluating the number of suppliers, their availability, substitution possibilities, storage risk, competitive demand and make-

or-buy opportunities (Kraljic, 1983). Each of the company's purchased items can now be categorized and placed in the appropriate quadrant in Figure 20 below (known as the 'Kraljic matrix').

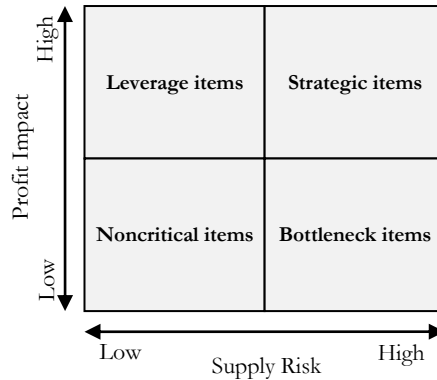


Figure 20: Classifying Purchasing Material Requirements (adapted from Kraljic, 1983, pp.111-112)

Each quadrant and category of items can be directly linked to a management dimension (Figure 19), as they possess the same characteristics (noncritical items correspond to purchasing management, strategic items correspond to supply management, and so on). Kraljic (1983) claims that by separating the procured items, the company could have a more differentiated, and thus more focused approach, in handling the different categories. Also, it is important not to use extensive amounts of resources on each category, but rather proportionate to their strategic implication. Kraljic (1983) acknowledged that the purchasing portfolio classification was static and needed updating in accordance with changes in market or demand patterns.

In **phase three** of the purchasing portfolio approach by Kraljic (1983), the focus is aimed at developing strategies specifically for the strategic items. With the author's goal of developing a sourcing strategy that can maximize the utilization of purchasing power vis-à-vis important suppliers, this phase involves positioning the strategic items in his purchasing portfolio matrix (Figure 21).

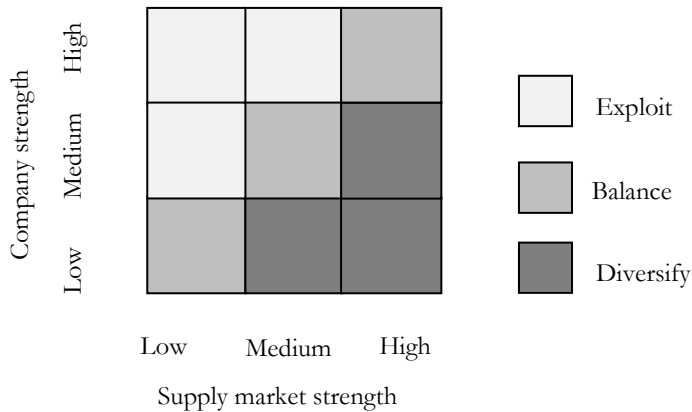


Figure 21: The Purchasing Portfolio Matrix (Kraljic, 1983, p.114)

The preceding phase (**phase two**) in the approach has determined the bargaining power of its suppliers against the company’s own. With this information, the power relationship against each strategic item supplier can be plotted in the matrix above (Figure 21). Depending on the placement in the matrix, each relationship to a supplier will be placed in one of three different risk categories, each with its own strategic thrust. For the *exploit* category, Kraljic (1983) recommends that the company uses its power advantage to gain favorable pricing and contract agreements, but not to an extent that will risk the continuation of the relationship in the future. For those relationships where the supplier has the power advantage (the *diversify* category), the company has to take a defensive position and search for alternative suppliers or substitute items. In this category, the company can, according to Kraljic (1983), consider the option of backward integrating if there is a shortage on suitable suppliers. The last category recommends a *balanced* strategy between the previous mentioned categories. The usefulness of the purchasing portfolio matrix (Figure 21) lies within its ability to evaluate risks, spot opportunities and vulnerabilities, and derive strategic thrusts for each relationship with supplier of strategic items (Kraljic, 1983).

The **last phase** of the purchasing portfolio approach results in distinct supply strategies which specify the content and timing of future actions for the strategic items. Based on the strategic thrusts developed in phase three, the elements that compose the generic sourcing strategy are determined. Kraljic (1983) summarizes these generic strategies as shown in Table 15.

Policy issues	Strategic thrust		
	Exploit	Balance	Diversify
Volume	Spread	Keep or shift carefully	Centralize, consolidate supply

Policy issues	Strategic thrust		
	Exploit	Balance	Diversify
Price	Press for reductions	Negotiate opportunistically	Keep low profile, accept higher prices
Contractual coverage	Buy spot	Balance contracts and spot	Ensure supply through contracts
New suppliers	Stay in touch	Select vendors	Search vigorously
Inventories	Keep low	Use stocks as “buffer”	Bolster stocks
Own production	Reduce or don’t enter	Decide selectively	Build up or enter
Substitution	Stay in touch	Pursue good opportunities	Search actively
Value engineering	Enforce supplier	Perform selectively	Start own program
Logistics	Minimize cost	Optimize selectively	Secure sufficient stocks.

Table 15: Strategic Implications of Purchasing Portfolio Positioning (adapted from Kraljic, 1983, p.115)

Further development of the Kraljic matrix

The Kraljic matrix, which is practiced today in numerous companies around the world, and has become the main strategic positioning tool when considering sourcing decisions (Cousins et al, 2008), has a somewhat different appearance today compared to the one Kraljic (1983) originally designed. In the further development of the Kraljic matrix there have been formulated overall purchasing strategies for each product category and the original matrix has been refined (Caniëls and Gelderman, 2007). In addition, the three strategies for the strategic quadrant from the original approach by Kraljic (1983) have been limited to the balance strategy (e.g. Hadelier and Evans (1994); Olsen and Ellram, 1997). This developed matrix (Figure 22) is commonly referred to as Kraljic’s portfolio matrix (Caniëls and Gelderman, 2005). We will now give a brief presentation of the recommended product category strategies.

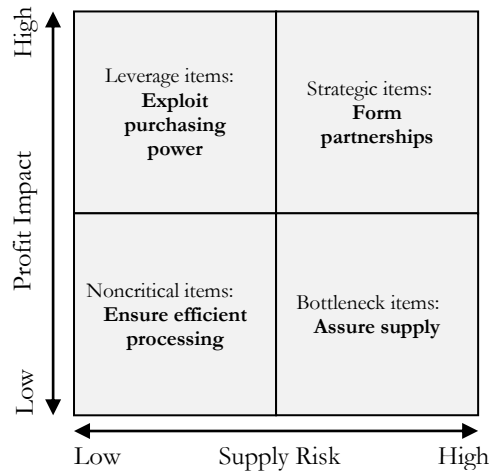


Figure 22: Further developed Kraljic matrix (adapted from Caniels and Gelderman, 2005, p.142)

Gelderman and van Weele (2005) explain that the *noncritical items* are of low value, and the company therefore wishes to reduce the transaction costs to an absolute minimum when sourcing these items. Strategies for this category are therefore aimed at reducing transaction costs; in recent times often through the use of e-procurement solutions. *Leverage items* represent a relatively large share of the end product’s cost in combination with relatively low supply risk (Caniels and Gelderman, 2007). Hence, the company has the possibility to utilize this low supply risk and take advantage of the resulting purchasing power in consolidating its purchases. Strategies for such items involve tendering, target pricing, multiple sourcing and product substitution, in aspiration for the best deal possible (Gelderman and van Weele, 2005). *Bottleneck items* represent items that are important in the delivery of the buyer firm’s products (Cousins et al., 2008), but are of low value, and thus a source of risk. The recommended purchasing strategy is therefore primarily focused on securing supply, even at an additional cost (Caniels and Gelderman, 2007). With *strategic items* it is advantageous to form strategic partnerships with the supplier; in order to reduce the high supply risk through mutual trust and commitments. Further, Caniels and Gelderman (2007) state that such a relationship with the supplier will lead to improvements in product design, quality, lead time and cost reduction.

3.4.2 Comparison of purchasing portfolio approaches

We will now provide a comparison of the most prevalent purchasing portfolio approaches (Kraljic, 1983; Elliot-Shircore and Steele, 1985; van Weele, 2010⁷; Olsen and Ellram, 1997; Bensaou, 1999; Nellore and Söderquist, 2000). First, we present a table that summarizes important characteristics of each approach (Table 16), as each described portfolio approach has made its unique contribution to the field of purchasing portfolio theory. This is followed by a more thorough comparison of some of the topics included in Table 16, structured under the following paragraphs: development of the purchasing portfolio approaches; utilizing buyer

⁷ This approach was first published in 1996, and has been updated in later issues of this book.

power; number of stages; and, empirical validation. Further, we briefly discuss the approaches with respect to time horizon, a company's scarce resources, and taking the buyer's perspective in subsequent paragraphs. Finally a conclusion is made, summarizing the most important findings.

Purchasing portfolio approaches

Author(s)	Kraljic	Elliot-Shircore and Steele	Olsen and Ellram	Bensaou	Nellore and Söderquist	van Weele
Year of publication (first issue)	1983	1985	1997	1999	2000	2010 (1996)
Main purpose of the approach	To make purchasing adapt to current environmental and economic changes	To initiate recognition of the priorities and real objectives for purchasing via the construction and maintenance of a highly flexible purchasing scenario, complete with self – evident information requirements, objectives and measures of effectiveness.	Managing the company's different suppliers	Managing a portfolio of relationships	Developing a purchasing portfolio model which incorporates the aspects of outsourced product development	Develop supplier strategies
Contribution	Provides the first purchasing portfolio approach	Presents a universal purchasing portfolio with and first to provide characteristics, suggested actions and aims for the different “category blocks”	Develops a more comprehensive approach. Provides more factors to consider when placing the products and supplier relationships in their respective portfolio models. Develops generic strategies and action plans	First to provide a management profile for each relationship type	Incorporates the role of specifications in the sourcing strategy. First to explain that a buyer can differentiate between suppliers within a category	First to provide generic strategies for all categories of products in the Kraljic matrix.
Number of stages in the approach	4 phases	1	3	3	2 steps in the first of 3 stages	3

Author(s)	Kraljic	Elliot-Shircore and Steele	Olsen and Ellram	Bensaou	Nellore and Söderquist	van Weele
Dimensions in the matrix						
Matrix in the first stage	-Profit impact -Supply risk	-Supply exposure/vulnerability -Profit/value potential In addition to a superimposed difference between strategic and tactical products	-Strategic importance of the purchase -The difficulty of managing the purchase situation	-Buyer's specific Investments -Supplier's specific Investments	Only tables provided in the first stage	Non existent
Matrix in the second stage	Non existent	Non existent	-Relative Supplier Attractiveness -Strength of the relationship	-Buyer's specific Investments -Supplier's specific Investments	-Market attractiveness -Strength of the relationship	-Purchasing's/ Supplier impact on profit -Supply risk
Matrix in the third stage	-Company strength -Supply market strength	Non existent	Non existent	-Relationship requirements -Actual relationship capabilities	Non existent	Only a table provided
Research design	No explicit research methodology mentioned	No explicit research methodology mentioned	Literature review	Survey/questionnaire	Literature review, two case studies and interviews	No explicit research methodology mentioned
Empirical foundation	Applied the approach on four large companies.	No empirical foundation	No empirical foundation	Questionnaire given to U.S. and Japanese automobile manufacturers	Four in-depth case studies, two automobile OEMs and two vehicle industry suppliers, in addition to a interviews at Toyota	No explicit empirical foundation

Table 16: Contribution and main characteristics of discussed purchasing portfolio approaches

Development of the purchasing portfolio approaches

In this paragraph, we show how the different purchasing portfolio approaches have developed over time, and how the approaches relate to each other. As mentioned previously (3.4.1), Kraljic (1983) developed the foundations for the modern purchasing portfolio approach as it is used today. Elliot-Shircore and Steele (1985) developed their own purchasing portfolio approach (“Positioning Overview”) in order to “lift purchasing activity out of the tactical fire fighting rut into a strategic role within the company” (p.26); as such, the purpose of using this approach is similar as for Kraljic (1983). Their approach provided characteristics and suggested actions for the different blocks of products. Further, the approach by van Weele (2010) was originally published in 1996, and has up to this day further built on Kraljic’ foundation, providing comprehensive generic strategies for all the different categories of products - not just for the strategic items which were the sole focus of Kraljic (1983). However, he preserves the three strategies recommended for the strategic quadrant, though under different names (‘buyer-dominated segment’, ‘balanced relationship’ and ‘supplier-dominated segment’).

In executing the first stage of their approach, Olsen and Ellram (1997) use a matrix which has considerable resemblance to the Kraljic (1983) matrix; however, their dimensions have a broader scope, incorporating additional purchase characteristics. Moreover, this approach is more comprehensive, analyzing the company’s current relationships before developing generic strategies and action plans. This is in contrast to the three previous purchasing portfolio approaches, who only consider the items sourced before recommending generic strategies. Nellore and Söderquist (2000) provide the most comprehensive approach. They expand the first step in the approach by Olsen and Ellram (1997), in order to incorporate a consideration for product development. They then utilize the remaining approach of Olsen and Ellram (1997) - conducting minor changes, and recommending generic strategies based on their own empirical data in addition to the other portfolio approaches discussed. Finally, Bensaou (1999) develops his own portfolio approach, which uses the same main purchase characteristics as Olsen and Ellram (1997) when assessing the contextual factors of a relationship. This approach is different from earlier developed purchasing portfolio approaches, as it does not recommend any generic sourcing strategies, only an appropriate management profile for each relationship.

Utilizing buyer power

In comparing the different approaches, we also discovered a change in focus with respect to the exploitation of buyer power in the approaches’ recommended sourcing strategies. Kraljic (1983) states explicitly that his suggested approach should result in a supply strategy which exploits the buyer’s purchasing power against important suppliers. Van Weele (2010), who builds his approach on the basis provided by Kraljic (1983), shares this focus on power and dependence, and further expands the focus to apply for all the different product categories - not just for the strategic sourced items. Van Weele (2010) further emphasizes that an important aspect of any purchasing strategy is the issue of influencing the balance of power between the buyer and the supplier: “In the author’s view the balance of power should preferably be in favor of the [buyer]... Obviously, when a company is too dependent on a supplier, something should be done to change the situation” (van Weele, 2010, p.195). As such, these portfolio approaches represent those with the greatest focus on utilizing buying power, out of the approaches

described. Olsen and Ellram (1997), however, emphasize that exploiting the buying power may be a “very dangerous strategy in today’s world because market conditions change rapidly” (p.106). Thus, the authors emphasize collaboration in their generic strategies as opposed to utilizing buyer power. It is fair to assume that also Nellore and Söderquist (2000) share this point of view, as they adopt many of the same generic strategies as proposed by Olsen and Ellram (1997). Elliot-Shircore and Steele (1985) and Bensaou (1999) take, on the other hand, a focus on power and dependence that lies between the aforementioned portfolio approaches. Elliot-Shircore and Steele (1985) do not provide a discussion on the usage of buyer power; as such, they take a neutral stance. However, their suggested actions are clearly inspired by transaction cost economics, thus avoiding dependence on suppliers and focusing on negotiation and monitoring of suppliers. In differentiating between different types of relationships, Bensaou (1999) uses a power and dependence argumentation, separating them on the basis of mutual exchange of specific investments. However, as his suggested approach does not recommend any specific generic strategies, it can be argued that Bensaou (1999) does not recommend exploiting buyer power or avoid dependence (which he knows is present in the relationship), but rather tries to manage the status quo as best as possible.

We are now able to map how the various approaches are related to time, each other, and their utilization of buyer power. This is depicted in Figure 23 below, which summarizes the discussion on development and the utilization of buyer power.

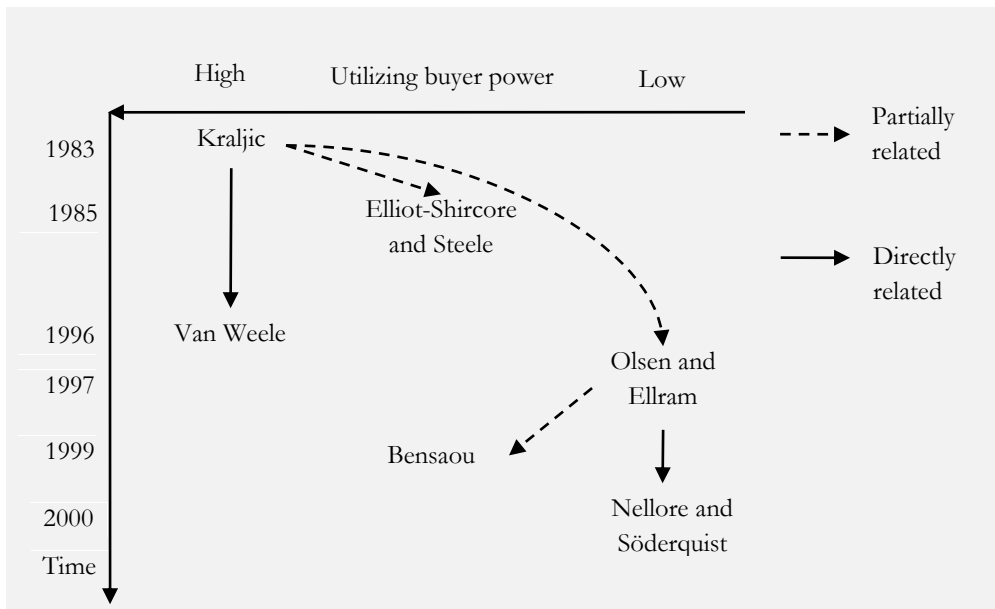


Figure 23: Development of the purchasing portfolio approaches over time

Number of stages

Of the portfolio approaches we have described, all have more or less three stages. However, there are large differences in terms of their extensiveness. Kraljic (1983), Elliott-Shircore and

Steele (1985) and van Weele (2010) use only one portfolio model to place the sourced products and, according to their placement, a generic strategy can be developed for the product. Kraljic (1983) uses one additional matrix to assess power-dependence in the buyer-supplier relationship for the strategic products, but only as a means for further specifying his generic strategy for those products.

The remaining approaches use 2-3 portfolio models each, aiding in an analysis of *the current sourcing strategy* in addition to *how the strategy should be*. Thus, these portfolio approaches incorporate a more comprehensive consideration of the company's unique characteristics and context. Olsen and Ellram (1997) use portfolio models both in the assessment of the sourced products (indicating how the strategy should be), and in the following step when analyzing their current suppliers (indicating the current strategy). These two steps together form the foundation for which the action plans are developed. Furthermore, the approach stands out, as it provides an elaborate description of its use and of the generic strategies. The description of use includes comprehensive lists of factors for measuring each of the dimensions, as well as a description of each quadrant, in both of the employed portfolio models. In addition to provide generic strategies in forms of action plans, Olsen and Ellram (1997) also provide guidelines as to how to prioritize the implementation of the developed action plans.

The purchasing portfolio approach Nellore and Söderquist (2000) utilizes, in part, the same portfolio models as Olsen and Ellram (1997), with only minor modifications to the model applied when assessing the supplier relationships. However, this approach lacks the same attention to detail, both in relation to the use of the approach and the generic strategies.

Bensaou (1999), on the other hand, starts with an analysis of the external conditions and choose an appropriate relationship type, before finding suitable management profiles based on the relationship types (indicating how the strategy should be). In the last stage of his approach, a comparison, utilizing a third portfolio model, is done of the actual relationship capabilities (indicating the current strategy) against how they ought to be, given by the preceding stage. A noteworthy attribute of this last approach is that there is not given any generic strategies, as opposed to the other approaches; the main objective is only to ensure that the portfolio of relationships is effectively managed and fitted to their external context.

Empirical validation

Of the presented purchasing portfolio approaches, Kraljic (1983) is the only one who has actually tested his approach. Through gathering experience of the usage of the approach from a welding materials producer, an electrical equipment manufacturer, a multinational chemical company and a heavy equipment manufacturer, the author argues that he has demonstrated the usefulness of the approach in a variety of industrial settings. However, one similarity between these companies is their size; they are all large. Bensaou (1999) developed his approach based on a questionnaire that was distributed among managers in large automobile manufacturers based in the U.S. and Japan. Nellore and Söderquist (2000) also departed from the automobile industry when they developed their approach, utilizing four in-depth case studies of two automobile OEMs and two medium-sized expert suppliers (a shock absorber and an air bag manufacturer)

together with a benchmarking interview of Toyota. Both Bensaou (1999) and Nellore and Söderquist (2000), however not empirically tested, have a solid foundation in empirical data. On the other hand, both approaches have departed from the same industry, which could question their applicability to other, rather different, industry contexts. The remaining presented approaches have no explicitly stated empirical foundation; however, Olsen and Ellram (1997) mention the need for further research on the usefulness of their portfolio approach. We recognize that of the few purchasing portfolio approaches that do have an empirical foundation, all have made this foundation on data from large companies, or from within the automobile industry.

Time horizon

There are some differences between the portfolio approaches with respect to the time horizon in which the proposed strategies are valid. Kraljic (1983) and Olsen and Ellram (1997) reveal how they intend their approaches to be used over time. Kraljic (1983) points out that the purchasing portfolio classification needs updating in accordance to changes in the market or demand. On the other hand, Olsen and Ellram (1997) incorporate time in their approach by separating between short-term and long-term goals. It is less obvious how the other portfolio approaches relate to the aspect of time.

A company's scarce resources

No company has unlimited access to resources. In his approach, Kraljic (1983) suggests that the company should use its resources proportionate to the strategic importance of the product category. Olsen and Ellram (1997) also emphasize the importance of freeing resources from less attractive supplier relationships, and redistribute them to more attractive and stronger relationships. Elliot-Shircore and Steele (1985) provide actions in order to minimize the resource consumption of the products categorized as *Tactical – Acquisition*; closer monitoring and price negotiations are not justified for such products. The authors also state that the extent of application of their purchasing portfolio approach will depend on the amount of resources the company has available. One important purpose of the last stage in the approach by Bensaou (1999) is to avoid an overdesign of the relationship, indicating an awareness of the company's limited resources. Furthermore, as Nellore and Söderquist (2000) adopt earlier developed generic strategies, it is fair to assume that the authors have preserved a conscious allocation of resources. However, despite building on the foundations given by Kraljic (1983), van Weele (2010) pays little attention to the resource consumption of the different generic strategies he proposes, and thus leaves the allocation of the resources up to the individual firm.

Buyers perspective

Finally, the last found characteristics of the described portfolio approaches is a tendency for viewing the buyer-supplier relationship solely from a buyer's perspective. Only Nellore and Söderquist (2000) take the supplier's perspective, and evaluate the suppliers' capabilities and capacities before recommending a strategy. According to them, there is a need to evaluate how the supplier is going to react, or even if he is willing to adapt, to the imposed generic strategy coming from his customer.

Conclusion

Our comparison of the different purchasing portfolio approaches shows how the approaches relate to each other, elucidating some of their identified differences and similarities. Further, each approach has made its unique contribution, and has different emphasis on subjects such as utilizing buyer power and use of a company's scarce resources. These findings may suggest that it is more valuable to combine the different approaches in relation to a company's unique situation instead of utilizing just one of these approaches, neglecting important contributions of other models. However, this is probably more demanding for a purchasing function, and the appropriateness of such a method will again be determined by the company's situation, and the recognized importance of the purchasing function.

3.5 Critique of purchasing portfolio approaches

The use of portfolio approaches in strategic planning has been criticized, and an elaboration of the received criticism is given in this section. This is done in order to enhance the understanding of the appropriateness, and limitations of a purchasing portfolio approach. First, a presentation of the industrial network approach is provided in order to give a different perspective on buyer-supplier relationships than the logic underlying portfolio analysis. Thereafter, we provide a summarization of identified critique of purchasing portfolio approaches. A conclusion then discusses the appropriateness of purchasing portfolio approaches, given the presented critique.

3.5.1 The industrial network approach

Dubois and Pedersen (2002) compare some of the better known portfolio models against the *industrial network approach*, in order to uncover how the different approaches handle relationships between suppliers and buyers in a purchasing context. Through their investigation of portfolio models, Dubois and Pedersen (2002) discovered that a fundamental assumption of most portfolio models is a focus on power-dependence. Consequently, a company will try to utilize its buyer power and avoid becoming dependent on a single supplier – to the largest extent possible (e.g. Kraljic, 1983). Dubois and Pedersen (2002) argue that the network approach captures important interdependencies between products which are lost in the portfolio approaches, as the following paragraph explains.

Dubois and Pedersen (2002) explain that the network approach uses the inter-firm relationships as a unit of analysis, rather than the individual company, and concentrates on how relationships connect to each other and how they are embedded in a wider relationship network. This connectedness causes relationships to be considered in relation to others and not as distinct dyads, as seen from the portfolio approach. The network approach provides a new understanding of how products actually are interdependent along several dimensions; Dubois and Pedersen (2002) argue that incorporating an industrial network approach can make the company “capture vital aspects of inter-firm interaction and interdependence within and between relationships” (p.41). For example, in the connection between the focal buyer-supplier relationship and the customer's other supplier relationships, Dubois and Pedersen (2002) acknowledge that a sourced product, with its unique technical features, needs to be adapted to the user's context. Often, this implies linking the product to other sourced products in order to use it, and, as such, there exist interdependence between the relationships providing these

products. This realization led Dubois and Pedersen (2002) to conclude that a product is part of a network, and it may be more appropriate to consider products as “network entities” rather than distinct “given” objects. However, Dubois and Pedersen (2002) also acknowledge that redirecting the purchasing portfolio approach, from concerning only products to consider relationships and networks, entails more complex and challenging analyses.

3.5.2 Identified critique of purchasing portfolio approaches

In this subsection, identified critique of purchasing portfolio approaches is summarized in Table 17 below. In addition, a paragraph concerning the approaches’ dimensions is included. Following this table, concluding remarks on the appropriateness of purchasing portfolio approaches, given the presented critique, are made.

	Critique	Author(s)	The authors' argumentation
<i>Relationships and supplier's perspective</i>	<i>Lack of focus on interdependencies between relationships and products</i>	Olsen and Ellram (1997); Dubois and Pedersen (2002)	Portfolio models create a dyadic context due to a strong reliance on balancing power-dependence, and because they are based on only two distinct dimensions. By limiting the focus to a purely dyadic context and not consider the relationship's network position, important potential for increased productivity and innovativeness is reduced (Dubois and Pedersen, 2002).
	<i>Portfolio models neglect the transaction cost incurred through breaking up established relationships and developing new ones</i>	Dubois and Pedersen (2002)	After a relationship with a supplier is established, the buyer starts to make adjustments in order to integrate this supplier into the buyer's business operations. The more adjustments made by the buyer, the more expensive it gets to terminate the relationship.
	<i>Rendering relationships as less attractive than they may be</i>	Zolkiewski and Turnbull (2002)	Relationships may constitute an important contribution to the company, despite being less attractive according to the two dimensions measured in a two-dimensional portfolio model. Expanding the model to consider multiple dimensions will provide a more comprehensive understanding of the relationships and their importance for the firm.
	<i>Ignoring the supplier</i>	Gelderman and van Weele (2003); Cox (2004); van Weele (2010)	In order to ensure an effective implementation of the recommended sourcing strategy, a "good fit between the position of the product into the buyer's purchasing portfolio and the position of the product in the supplier's customer portfolio is necessary" (van Weele, 2010, p.200); e.g. a partnership with a supplier is only feasible if it is the strategic intent of both parties (Gelderman and van Weele, 2003). As such, a buyer cannot make a sourcing decision in isolation, a reason being that the supplier will have its own goals and motives (Cox, 2004).
<i>Positioning of the products</i>	<i>Viewing products as "given" objects</i>	Dubois and Pedersen (2002)	Important aspects such as developing, producing and using the product are neglected when viewing products as "given". Purchasing portfolio models often use products as a basis for analysis, which entails that the above mentioned aspects are neglected in the analysis.

	Critique	Author(s)	The authors' argumentation
	<i>Limited guidance in how to manage a category, after the classification is made</i>	Olsen and Ellram (1997); Nellore and Söderquist (2000)	A portfolio model fails to provide the means for which to choose amongst the developed strategies; both between the category strategies and amongst the different strategies recommended within a category (Olsen and Ellram, 1997). Portfolio models, by developing independent strategies for each of the categories, can recommend generic strategies that are contradictory (Nellore and Söderquist, 2000)
<i>Strategic recognition</i>	<i>Portfolio models impede purchasing's strategic recognition</i>	Dubois and Pedersen (2002)	Using the portfolio models to decide how to handle purchasing may indicate one of two situations: (1) as portfolio models handle distinct "given" products, using such models may imply that the purchasing function has a mere clerical function; (2) "it may be that purchasing is side-stepped because buyers prefer to deal with purchasing as an isolated phenomenon" (p.41).
	<i>The dimensions in a portfolio approach are only approximate estimations of the factors they are supposed to measure</i>	Lilliecreutz and Ydreskog (1999); Nellore and Söderquist (2000); Dubois and Pedersen (2002); Zolkiewski and Turnbull (2002); Trautmann et al. (2009); Terpend et al. (2011)	The complex sourcing situation entails that two dimensions will never be able to capture all the possible situations and their recommended actions.
<i>Dimensions</i>	<i>The dimensions in a portfolio approach cause an emphasis on the company's boundary</i>	Dubois and Pedersen (2002); Terpend et al. (2011)	The two dimensions in the portfolio models often measure an internal and an external variable, causing an emphasis on the company's boundary – possibly overlooking important existing interdependencies between internal and external factors.
	<i>The process of classifying the items along the two dimensions can be confusing</i>	Nellore and Söderquist, (2002); Terpend et al, 2011	Many products will not fit exactly within a discrete category, and some products do not match any category.
	<i>Measurement along the dimensions</i>	Olsen and Ellram (1997); Zolkiewski and Turnbull (2002); Gelderman and van Weele (2003; 2005)	It is difficult to separate "high" from "low" – this will in turn make the choice of strategy difficult.

Table 17: Critique of purchasing portfolio approaches

The dimensions in a portfolio model

From Table 17 above, we recognize that a lot of the critique of purchasing portfolio approaches concerns the dimensions of the approach. In order to achieve a nuanced presentation with respect to the dimensions, we have chosen to elaborate some more. Olsen and Ellram (1997) emphasize that the dimensions used to categorize the items in the portfolio model should have the “right” balance of complexity. Important factors may be neglected if the dimensions are too simple. On the other hand, if they are too complex, a company may consume too much time and effort in categorizing the items, causing them to “not realize the full potential of the portfolio approach in terms of improved resource allocation and communication” (Olsen and Ellram, 1997, p 102). Too complex dimensions may, according to Nellore and Söderquist (2000), also cause the company to be a victim of means-end confusion; it is important to remember that “the classification is not an end in itself, but a means to aid in the development of the appropriate action plans” (Nellore and Söderquist, 2000, p.263). Furthermore, Olsen and Ellram (1997) argue that high complexity of the dimensions may make it hard to implement the use of the portfolio model.

3.5.3 Concluding arguments

The aforementioned criticism of the purchasing portfolio models may suggest that these models should be used with a consideration of their limitations, and preferably together with other tools (Olsen and Ellram, 1997). Gelderman and van Weele (2005) discover that much of the critique aimed at the portfolio approach is derived from conceptual studies; whereas arguments supporting this approach have been reported from a limited set of case studies. Further, Gelderman and van Weele (2003) discover that experienced practitioners of purchasing portfolio approaches have devised effective solutions to several of the mentioned problems (e.g. the disregard for the supplier and measurement along the dimensions). Terpend et al. (2011) recognize that the existing portfolio models provide a foundation for strategic planning; however, they are not able to predict every possible purchasing situation. According to Terpend et al. (2011), this finding is in accordance with the *incrementalist perspective* on strategy formulation (Mintzberg, 1978; referred to in Terpend et al., 2011), which states that managers adapt strategies to changing environments, and strategy formulation is subject to the bounded rationality of managers conceiving them. Thus, as a purchaser, one cannot rely solely on the predetermined categories provided by the portfolio models, but one must maintain the ability to adjust the strategy as changes occur (Terpend et al, 2011).

3.6 Power and dependence in buyer-supplier relationships

The concepts of power and dependence are considered important when developing an understanding of buyer – supplier relationships (Caniëls and Gelderman, 2005; 2007; Kibbeling et al, 2009). The existence of differences in power and dependence between buyers and suppliers also seems to be a fundamental assumption underlying all purchasing portfolio models (Dubois and Pedersen, 2002; Caniëls and Gelderman, 2005). As previously discussed, utilizing buyer power had an extensive focus in the earlier purchasing portfolio approaches; more recent approaches have acknowledged the danger of such an approach towards suppliers (3.4.2). In this section we will elaborate on the related concepts of power and dependence, and discuss their

implications for the usage of a purchasing portfolio approach; both in relation to portfolio models and the feasibility of sourcing strategies.

3.6.1 Defining power and dependence

A company will always depend on their business partners, to different extents (Caniëls and Gelderman, 2005). Kibbeling et al. (2009) explain that such dependence is created by the desire to obtain specific resources. One example mentioned by Caniëls and Gelderman (2005), is the need for technological expertise for both suppliers and buyers. Suppliers are in need of the specialized knowledge of its customers (the buyers), and the buyers need increasingly technologically advanced suppliers. From the example above, we see that the dependence is mutual. In close relation to the concept of mutual dependence, is the concept of power (Caniëls and Gelderman, 2005). Pfeffer (1981) states that power is created by possessing something that someone else wants. The author proceeds by explaining that the relative power of one company over another is created by the net dependence one over the other. If company A depends more on company B than company B depends on company A, then company B has power over A (Pfeffer, 1981). Caniëls and Gelderman (2007) state that a position of dependence for a buyer implies vulnerability; thus, the disadvantages associated with this vulnerability must be offset by the benefits gained from the relationship.

In order to establish a sufficient understanding of the interdependence (and thus power) of a dyadic relationship, one must evaluate both *relative power* and *total power* (Caniëls and Gelderman, 2005). Caniëls and Gelderman (2005) state that relative power is “the difference between supplier’s dependence and buyer’s dependence” (p. 144). Total power (or total interdependence), an indicator of the intensity of the relationship, is determined by the combined interdependence of the actors involved in the relationship (Caniëls and Gelderman, 2005). As a means for measuring power, Caniëls and Gelderman (2005) develop indicators of buyer’s and supplier’s dependence, derived from literature. These are shown in Table 18.

Buyer’s dependence	Supplier’s dependence
Logistical indispensability	Financial magnitude
Need for supplier’s technological expertise	Need for buyer’s technological expertise
Availability of alternative suppliers	Availability of alternative buyers
Switching costs buyer	Switching costs supplier
Overall buyer’s dependence	Overall supplier’s dependence

Table 18: Aspects that compose buyer's dependence and supplier's dependence (adopted from Gelderman and Caniëls, 2005).

3.6.2 Power and dependence in relation to purchasing portfolio models

As discussed in the introduction to this subsection, the existence of an underlying difference in power and dependence is present in all purchasing portfolio models. Caniëls and Gelderman

(2005) illustrate this connection between the concept of power and purchasing portfolio models through discovering that a buyer’s perceived power balance between buyer and supplier is strongly associated with the assessed level of supply risk (the second dimension of the Kraljic matrix; 3.4.1). Furthermore, the authors argue that “the level of buyer’s and supplier’s dependence largely determine the position of a purchasing strategy within the Kraljic Matrix” (Caniëls and Gelderman, 2005, p.152). They further explain that positions in the bottleneck and strategic quadrants are associated with supplier relationships where the supplier possesses the relative power, whereas a positioning in the leverage or non-critical quadrant indicates a more power-balanced relationship. In a later article, Caniëls and Gelderman (2007) compare the role of power and dependence between theory and practice, for each of the four quadrants in the Kraljic Matrix. Their results are shown in Table 19.

	Relative power		Total interdependence	
	Expected	Observed	Expected	Observed
Strategic	Balanced	Supplier dominance	Highest	Highest
Bottleneck	Supplier dominance	Supplier dominance	Moderate	Moderate
Leverage	Buyer dominance	Buyer dominance	Moderate	Moderate
Non-critical	Balanced	Balanced	Lowest	Lowest

Table 19: Comparison of relative power and total interdependence in the Kraljic matrix: theory and practice (Caniëls and Gelderman, 2007, p.227).

3.6.3 The feasibility of the recommended sourcing strategies

Cox (2004) makes a connection between purchasing portfolio approaches and the concept of power. He argues that the recommended sourcing strategy provided by an approach, for a certain product, may not be applicable despite being “ideal”. Cox (2004) realizes that what an appropriate approach is for a buyer in its relationship with a supplier in “one circumstance (of continuous, high volume, standardized demand) is unlikely to be appropriate in another (where there is infrequent, low volume and non-standard demand)” (p.348). The most “appropriate” manner for a buyer to manage its relationship with a supplier depends on the power and leverage circumstances that encompass the relationship (Cox, 2004).

Further, when describing the different sourcing approaches available for a buyer, Cox (2004) defines the approach of *supply chain management* (characterized as proactive and with an incorporation of the whole supply chain) as the potentially most advantageous. However, the author acknowledges that such an approach is the most difficult to implement, due to reasons of power and leverage. A *first reason* is that supply chain development tends to work best when the buyer has relative power over its supplier. A *second reason* for a buying company for failing in achieving its intended sourcing strategy, is, according to Cox (2004), that buyers (and suppliers) “misperceive circumstances and pursue inappropriate relationship management styles, given the internal and external power circumstances they are operating in” (p.353). In addition, the author

provides a *third reason* for why few companies are able to achieve the supply management approach; a company does not have the sufficient capabilities or resources to undertake such a resource intensive approach (Cox, 2004).

From this connection between the concepts of power and dependence, purchasing portfolio approaches and sourcing strategy, it can be argued that these are important concepts to consider when using a purchasing portfolio approach – even more so for those approaches where there is a greater emphasis on utilizing power (i.e., Kraljic, 1983; van Weele, 2010; 0). In the next section, we conclude this chapter by stating what will be brought along to the theoretical framework.

3.7 Towards the theoretical framework – Purchasing portfolio approaches

The main purpose of this chapter has been to provide a necessary understanding of the concept of purchasing portfolio approaches. Several central topics related to the concept have been presented. We will now gather and classify findings that will be brought along to the construction of a theoretical framework at the end of this part. These findings will subsequently be used, both for answering RQ1 and structuring and guiding the analysis. In the analysis (chapter 8), these findings will be refined using empirical data gathered through our mixed methods research, c.f. 2.1.3.

The first relevant finding to be included in the theoretical framework is the fundamental context of using a purchasing portfolio approach; making sourcing strategies (3.1.1). Further, referring to other main purposes of using a purchasing portfolio approach (3.3.1), we argue that different stated purposes can be organized within three groups: *Balancing the portfolio of relationships* (Wind and Mahajan, 1981; Turnbull, 1990; Pagell et al., 2010; Nellore and Söderquist, 2000; Day et al., 2010); *organizing information* (Olsen and Ellram, 1997; Syson, 1992); *facilitating communication* (Gelderman and van Weele, 2002; Smart and Dudas, 2007; Olsen and Ellram, 1997; Trautmann et al, 2009). As such, we find it advantageous to include these three groups of purposes in the theoretical framework.

We have in this chapter described the most prevalent purchasing portfolio approaches (Kraljic, 1983; Elliot-Shircore and Steele, 1985; Olsen and Ellram, 1997; Bensaou, 1999; Nellore and Söderquist, 2000; van Weele, 2010). Their contribution and main characteristics will be included in the theoretical framework. Further, the comparison of these approaches (3.4.2), with respect to utilizing buyer power; development of the approaches; number of stages and buyer's perspective, will be brought along to the theoretical framework.

Further, in reviewing critique of purchasing portfolio approaches, we found that the critique could be categorized into four main categories: *positioning of the products, dimensions, relationships and the supplier's perspective*; and, *strategic recognition* (3.5; Table 17). These categories are included in the theoretical framework. The final topic to be included in the theoretical framework is the concept of power and dependence, as it is argued to be a fundamental assumption underlying all purchasing portfolio approaches (3.6). In summary, the findings to be brought along to the development of a theoretical framework are illustrated in Figure 24 below.

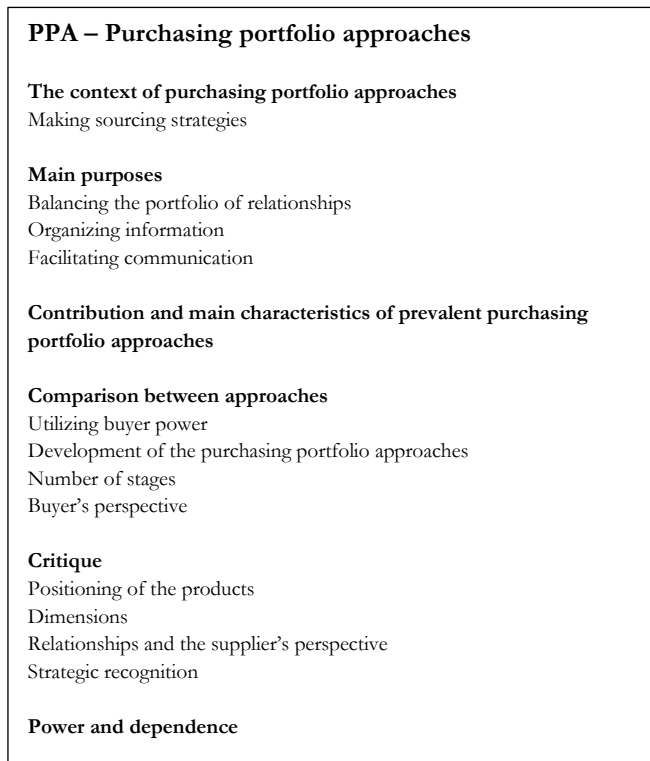


Figure 24: Findings from PPA brought along to the theoretical framework

4 Purchasing sophistication

The purpose of this chapter is to gain a fundamental understanding of the concept of purchasing sophistication. First, definitions of purchasing sophistication and its perceived equivalents are provided. Second, an overview of purchasing maturity models (also referred to as development models) is given, as purchasing sophistication is closely related to such models. As there is some critique posted on such models, this is paid attention to in a succeeding subsection. Thereafter, a discussion of the findings is given, before we summarize the findings that will be brought along to the theoretical framework.

4.1 Definitions and applications from literature

A relatively sparse body of literature is identified with respect to purchasing sophistication. There appears to be little consensus on a fixed term reflecting purchasing sophistication; both maturity and professionalism are seemingly also used to express the concept of purchasing sophistication. No literature reviews on purchasing sophistication are identified, and existing literature tends to connect sophistication to other topics. The following topics are identified, and will be further described in the subsequent sections: Purchasing sophistication... (1) from the marketer's perspective; (2) and purchasing's strategic influence; (3) and corporate purchasing synergy; (5) and the use of purchasing portfolio models; (6) and firm performance.

4.1.1 Purchasing sophistication from the marketer's perspective

Contributing to the 1980s' stream of literature on purchasing's importance (see 1.1.4), the article "Impact of Purchasing Trends on Industrial Marketers" by Guinipero and Zenz was published in 1982. The authors examine how the (then) recent trends in the development of purchasing have an effect on the field of marketing. As the authors put it, "it is important that industrial marketers better understand these changes and subsequently implement marketing efforts that complement the purchasing environment of the 1980s" (p.17), as marketers often have lagged behind in adjusting their perspective to changes in the sales/purchasing interface (Guinipero and Zenz, 1982).

In conducting their study, an underlying presumption is that "sales personnel in the 1980s are making sales calls on a new class of professional buyer" (Guinipero and Zenz, 1982, p.21). The authors build this presumption on three measures that determine the extent of professionalism in purchasing: (1) Membership in a professional purchasing organization; (2) attainment of the rank Certified Purchasing Manager; and (3) participation in internal or external training programs. The authors argue that membership in a professional purchasing organization (such as the American NAPM, The National Association of Purchasing Management⁸) brings benefits in the shape of "(1) increased job knowledge, (2) personal development, (3) mental stimulation via exposure to thoughts and ideas different from those of the member corporation, and (4) chance to attain certification in the field" (p.22). Further, Guinipero and Zenz (1982) describe an increase in certification at the time, which they find to be due to management recognition of certification and willingness to pay higher salaries to, and promote, certified purchasers. They also note that increased professionalism tends to increase emphasis on training and education.

⁸ The American equivalent to NIMA in Norway.

Guinipero and Zenz (1982) conclude, inter alia, that within the 1980s environment, with a highly trained purchasing workforce, “sales personnel must become increasingly sophisticated and productive to meet growing expectations professional purchasers will have on salespeople” (p.23). As they take the marketer’s perspective, the authors do not provide any guidelines to purchasers with respect to becoming (more) professional; they merely point out that the three aforementioned measures determine the extent of professionalism in purchasing.

4.1.2 Purchasing sophistication and purchasing’s strategic influence

In 1983, Kraljic’s article “Purchasing Must Become Supply Management” was published in Harvard Business Review. The article is one of the most influential articles in the 1980s’ stream of purchasing literature. In the article, the author presents a two-by-two matrix (‘Exhibit I’, as seen in Figure 19; see 3.4.1) that classifies the “Stages of Purchasing Sophistication” (p.111) within companies. By determining the *strategic importance of the purchase* and the *complexity of the supply market*, the required purchasing sophistication can be determined. The four stages of purchasing sophistication are (1) purchasing management; (2) materials management; (3) sourcing management; and (4) supply management. Kraljic (1983) never explicitly defines what he means by purchasing sophistication; he provides step-by-step pragmatic advice on how to identify supply weaknesses and treat them with comprehensive strategies to manage supply. However, in Exhibit I, each stage is evaluated with respect to procurement focus; time horizon; key performance criteria; items purchased; typical sources; supply; and, decision authority. Further, when classifying purchasing materials requirements (‘Exhibit II’), the stages of purchasing sophistication vary with an increasing intensity in main tasks, required information and decision level.

According to Pearson and Gritzmacher (1990), “evidence and intuition suggest that firms that develop their purchasing function and integrate it into the strategic management process may be in a better position to survive and to compete successfully in the future” (p.99). The authors argue that three factors appear to have created the need for an integration of purchasing into the strategic decision making process: Higher level of competition; the dynamic supply environment of the firm; and, the changing nature of the purchasing function. The justification for the purchasing function to be included in the strategic decision-making process depends, according to Pearson and Gritzmacher (1990), on the sophistication level of the purchasing function, which they define as the following: “the sophistication level of purchasing within an organization determines to a great extent its role in and integration into the strategic management decision making process” (p.93). The authors provide seven key characteristics that can determine the level of sophistication: (1) organizational structure; (2) organizational perceptions; (3) information access; (4) information technology; (5) decision issues; (6) supplier network and relationships; and, (7) strategic management. Table 20 explains the seven key characteristics, as given by the authors. Here, the operational approach refers to a traditional, clerical approach (low sophistication), whereas the strategic approach describes characteristics needed in order for purchasing to influence the strategic management decision-making (high sophistication).

PURCHASING AS A STRATEGIC FUNCTION		
Characteristics	Operational approach	Strategic approach
Organization structure	Low visibility, lengthy reporting chain to top management	High visibility, direct reporting to top management
Organization perception	Isolated ineffective paper pushers	Active, effective strategic material supply managers
Information access	Limited exposure to critical reports and meetings	Access to a library of internally and externally generated information
Information technology	Inundated by non-computerized data	Paperless computer integrated information system
Decision issues	Clerical function that makes decision	Provides expert analysis of forecasting, sourcing, delivery and supplier information
Supplier network and relationships	Works with many suppliers. Adversarial relationships	Works with fewer suppliers. Cooperative family relationships
Strategic management	Non-existent input to the strategic management decision making process	Chief strategist of material price, availability and supplier issues. Provides critical information to strategic management

Table 20: Purchasing as a strategic function (Pearson and Gritzmacher, 1990, p.94)

Pearson and Gritzmacher (1990) acknowledge that “little if any information exists to document a firm's level of purchasing sophistication” (p.99), and that future studies should, among other, attempt to identify a firm's level of purchasing sophistication.

4.1.3 Purchasing sophistication and corporate purchasing synergy

According to Cousins et al. (2008), the location, shape and form within the organizational structure become critical when purchasing and supply management becomes a strategic part of the organization. Rozemeijer et al. (2003) examine, through a survey, the nature and extent of purchasing synergetic activities in large corporations; that is, how large corporations may effectively manage purchasing synergies among individual business units. They test three constituent variables when examining what corporate purchasing officers need to tailor their approach based on: *The external business context of the corporation, corporate coherence and purchasing maturity*. The external business context is found to have little significance when it comes to purchasing synergy. However, the survey results suggest that corporate coherence and purchasing maturity have a relation with the measures taken to stimulate cooperation across business units. Hence, Rozemeijer et al. (2003) argue that corporate purchasing initiatives should be congruent with these. This relationship is illustrated in Figure 25.

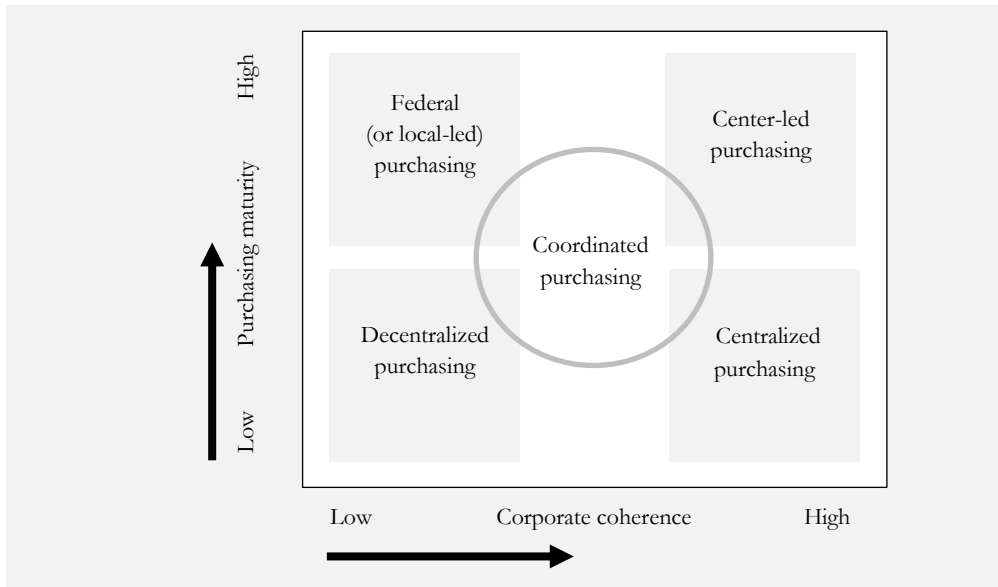


Figure 25: Corporate purchasing organizational approaches (Rozemeijer et al., 2003, p.11)

According to the authors, corporate coherence relates to the extent to which different parts of the corporation operate and are managed as one entity. Purchasing maturity reflects the level of professionalism in the purchasing function; expressed by status of the function, role and organizational status of the purchasing department, availability of purchasing information systems, quality of the people involved in purchasing and level of collaboration with suppliers (Rozemeijer et al., 2003). The purchasing maturity construct was developed from purchasing development models published over the last decade by international consultants and academics (Rozemeijer et al., 2003). The authors do not provide any guidelines to measure the maturity of a firm; neither do they suggest how a purchasing function can become more mature. They do, however, suggest that when the purchasing function is highly mature, companies will utilize a more advanced approach to manage corporate purchasing synergy than when the function is less mature.

4.1.4 Purchasing sophistication and the use of purchasing portfolio models

In their article on purchasing portfolio approaches, Gelderman and van Weele (2005) address the question of whether or not the use of purchasing portfolio models is considered as an indication of purchasing sophistication. Referring to Rozemeijer et al. (2003), they define purchasing sophistication as “the level of professionalism of the purchasing function” (p.22), and equate sophistication and maturity. In exploring the correlation between the use of purchasing portfolio models and purchasing sophistication, Gelderman and van Weele (2005) use the following characteristics to develop a purchasing sophistication construct: (1) Reporting level of the purchasing function; (2) the contribution to the competitive position of the company; (3) an orientation on collaborative supplier relationships; (4) the skills to participate in

cross-functional teams; (5) skills for developing purchasing and supplier strategies; and (6) a focus on clerical and administrative duties. According to the authors, the six characteristics constituting their purchasing sophistication construct are, like the maturity construct by Rozemeijer et al. (2003), derived from different purchasing maturity/development models. The six characteristics and their requirements for a sophisticated purchasing function are summarized in Table 21.

PURCHASING SOPHISTICATION CHARACTERISTICS	
Reporting level	A highly sophisticated purchasing function would report directly to top management, whereas a firm with a low level of sophistication would have a lengthy reporting chain.
Contribution to competitive position	A sophisticated purchasing function, in contrast to an immature function, will be considered as an important resource for the firm
Orientation on collaboration	A sophisticated purchasing function should have an orientation toward collaborative relationships with suppliers
Cross-functional teams	The skills to participate in cross-functional teams are likely to be associated with the purchasing sophistication of companies.
Developing strategies	Purchasing personnel in companies with a more sophisticated approach to purchasing will have the skills to develop differentiated purchasing and supplier strategies.
Clerical activities	Buyers in a non-sophisticated purchasing function solve day-to-day problems with suppliers and spend their time mainly on clerical and administrative tasks.

Table 21: Purchasing sophistication characteristics (adapted from Gelderman and van Weele, 2005)

Gelderman and van Weele (2005) distributed a questionnaire to the members of the Dutch Association of Purchasing Management (NEVI), where respondents were asked to score questions relating to the six different characteristics of purchasing sophistication on a five-point Likert scale. In analyzing the data, factor analysis indicated that purchasing sophistication is a two-dimensional construct consisting of purchasing professionalism and purchasing's position within companies. Further, Gelderman and van Weele (2005) found a positive correlation between the position of the purchasing organization in the overall company hierarchy and the usage of portfolio models. From this, they argue that "the same conclusion holds for the professionalism of the purchasing function" (Gelderman and van Weele, 2005, p.25), i.e., purchasing portfolio models are used more often by more professional purchasers than by less professional purchasers. These arguments were then said to contribute to the evidence that portfolio usage is associated with purchasing sophistication.

With respect to the purchasing sophistication factors (see above), purchasing professionalism refers to the skills of purchasing (cross-functional teams and developing strategies) and their (negative) orientation toward, and engagement in, clerical activities. Purchasing position refers to

the internal position and status of the purchasing function in companies, deduced from its contribution to the company's competitive position and its direct reporting to top management (Gelderman and van Weele, 2005). The authors remove the "orientation on collaboration" characteristic from the analysis, as it cross-loads on both the professionalism and status factors.

Gelderman and van Weele (2005) do not address causality in the aforementioned correlation; however, they argue that it is possible that the introduction of purchasing portfolio approaches in companies is a driver for purchasing sophistication, and that "adopting a portfolio approach could work as a catalyst for change within the company" (p.25). Further, it could put purchasing "higher on the company's strategic agenda, clarifying the problems and possibilities of purchasing and supplier management" (Gelderman and van Weele, 2005, p.25). However, they emphasize that one has to consider the prerequisites, with regard to both the needed professionalism and domain of the purchasing function within the company, to be able to apply purchasing portfolio management.

4.1.5 Purchasing sophistication and firm performance

In a relatively recent article, Schiele (2007) investigates the relationship between the development level of a purchasing organization – maturity – and its impact on the performance of a firm. The rationale is that as the purchasing volume expressed as a percentage of a firm's total turnover has risen substantially in the recent years, a better performance may make a considerable contribution to a firm's overall performance (Schiele, 2007). The author develops a purchasing development model, which is used to test the relationship between purchasing maturity and firm performance; the latter measured by 14 companies' success in a purchasing cost-reduction programme. Referring to Rozemeijer et al. (2003), Schiele defines purchasing maturity as "the level of professionalism of the purchasing function" (p.22).

We have chosen to look further into the model in a subsequent section on maturity models (4.2); however, the author's perception of purchasing maturity seems fit to include here. Schiele (2007) takes a managerial approach to purchasing, and presents a five-dimensional profile of purchasing maturity, consisting of: (1) procurement planning; (2) the structural organization of the purchasing function; (3) process organization and purchasing's embeddedness in the firm; (4) established human resource systems and leadership models in procurement; and (5) purchasing controlling structures. The dimensions are, as for Rozemeijer et al. (2003) and Gelderman and van Weele (2005), deduced from literature on development models and commonalities in these. Schiele (2007) also finds that "collaborative supplier relations" is a common dimension of such models. However, he omits it, as it cannot be deduced from a management model; "a classical management approach (...) does not favour any single strategy" (p.277). Each of the five dimensions contains several items that are used to assess a firm's purchasing maturity, and we choose to refer to the article by Schiele (2007) for a further elaboration of these.

Schiele (2007) confirms a positive relationship between maturity and firm performance. Initially, he expected that firms with a low degree of maturity would have a larger savings potential; however, he was surprised to find that the new method performed better with mature

organizations. Schiele (2007) uses the concept of absorptive capacity to explain this. The following definition of absorptive capacity is given by Cohen and Levinthal (1990): “We argue that the ability to evaluate and utilize outside knowledge is largely a function of the level of prior related knowledge. At the most elemental level, this prior knowledge includes basic skills or even a shared language but may also include knowledge of the most recent scientific or technological developments in a given field. Thus, prior related knowledge confers an ability to recognize the value of new information, assimilate it, and apply it to commercial ends. These abilities collectively constitute what we call a firm’s ‘absorptive capacity’” (p.128).

Cohen and Levinthal (1990) argue that as a firm invests more in research and development activities, it will be able to appreciate the value of new external information in a larger degree. Schiele (2007) finds it likely that there is a positive relationship between the maturity of the purchasing function and its absorptive capacity. He uses this *purchasing absorptive capacity* to interpret the poor performance of unsophisticated purchasing functions in utilizing his development model. According to Schiele (2007), the absorptive capacity concept argues that an organization needs to have achieved a ‘minimum maturity point’ in order to reap the benefits of best practices. He argues that different techniques for development are necessary for different levels of maturity; with low maturity, the basics have to be established first, whereas highly mature organizations can utilize best-practice knowledge immediately due to sufficient absorptive capacity (Schiele, 2007). The minimum maturity point is illustrated in Figure 26 below. According to the author, one should consider the minimum maturity point, below which there is nothing to be gained by the introduction of best practices, when introducing best practices. “Leapfrogging” development by over-investing in methods, tools and so on could be counterproductive (Schiele, 2007). Schiele (2007) argues that the positive relationship between purchasing maturity and performance may encourage firms to set up more sophisticated purchasing functions, and that resources dedicated to this purpose are likely to pay off.

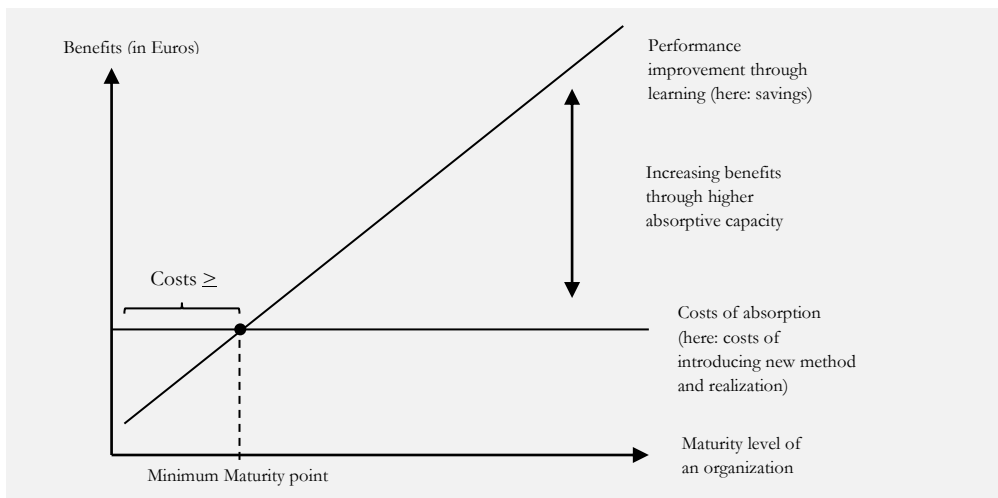


Figure 26: The minimum maturity point (adapted from Schiele, 2007, p.282)

We have now presented articles that address the concept of purchasing sophistication. Table 22 summarizes descriptions of purchasing sophistication identified in the literature. As several of these are deduced from maturity (or development) models, the next subsection provides a brief overview of such models.

Author(s)	Term	Evaluated with respect to	Characteristics determining purchasing sophistication	Prerequisite for (high) sophistication
Guinipero and Zenz (1982)	(Extent of professionalism in purchasing)	The marketer's perspective on the professional buyer	Membership in a professional purchasing organization	<i>Coincides with the characteristics determining purchasing sophistication.</i>
			Attainment of the rank Certified Purchasing Manager	
			Participation in internal or external training programs	
Kraljic (1983)	(Stages of purchasing sophistication)	Purchasing must become supply management	Purchasing management	<i>N/A</i>
			Materials management	
			Sourcing management	
			Supply management	
Pearson and Gritzmacher (1990)	Sophistication level of purchasing	Purchasing's influence on the strategic decision-making process	Organization structure	High visibility, direct reporting to top management
			Organizational perceptions	Active, effective strategic material supply managers
			Information access	Access to a library of internally and externally generated information
			Information technology	Paperless computer integrated information system
			Decision issues	Provides expert analysis of forecasting, sourcing, delivery and supplier information

			Supplier network and relationships	Works with fewer suppliers. Cooperative family relationships
			Strategic management	Chief strategist of material price, availability and supplier issues. Provides critical information to strategic management
Rozemeijer et al. (2003)	Purchasing maturity (level of professionalism in the purchasing function)	Corporate purchasing synergy	Status of the function	<i>N/A</i>
			Role of the purchasing department	
			Organizational status of the purchasing department	
			Availability of purchasing information systems	
			Quality of the people involved in purchasing	
			Level of collaboration with suppliers	
Gelderman and van Weele (2005)	Purchasing sophistication	The use of purchasing portfolio models	Reporting level	A highly sophisticated purchasing function would report directly to top management, whereas a firm with a low level of sophistication would have a lengthy reporting chain.
			Contribution to competitive position	A sophisticated purchasing function, in contrast to an immature function, will be considered as an important resource for the firm
			Orientation on collaboration	A sophisticated purchasing function should have an orientation toward collaborative relationships with suppliers

Schiele (2007)	Purchasing maturity	Firm performance	Cross-functional teams	The skills to participate in cross-functional teams are likely to be associated with the purchasing sophistication of companies.
			Developing strategies	Purchasing personnel in companies with a more sophisticated approach to purchasing will have the skills to develop differentiated purchasing and supplier strategies.
			Clerical activities	Buyers in a non-sophisticated purchasing function solve day-to-day problems with suppliers and spend their time mainly on clerical and administrative tasks.
			Procurement planning	<i>There is a threshold level for the implementation of 'best practices'</i>
			The structural organization of the purchasing function	
			Process organization and purchasing's embeddedness in the firm	
			Established human resource systems and leadership models in procurement	
			Purchasing controlling structures	

Table 22: Overview of identified literature on purchasing sophistication

4.2 Purchasing development models

As seen in 4.1, purchasing sophistication characteristics are often deduced from purchasing development models. As such, we see it beneficial to provide some insight in such models. First, the concept of development models is defined, and a sample of some of the existing purchasing development models is described. Thereafter, we elucidate critique of such models.

4.2.1 Definition and examples from literature

When considering the professional development of the purchasing function in organizations, many authors suggest conceptual models assuming a stage- or step-wise development (Rozemeijer, 2000; van Weele, 2010). Such models are most often termed maturity or development models. We here choose to use these terms interchangeably, depending on what the respective authors use. Schiele (2007) offers a straightforward definition of the concept: “A maturity model describes several – auditable – stages an organization is expected to go through in its quest for greater sophistication” (p.274). According to Rozemeijer (2008), development models are relatively new in the purchasing discipline; however, development models within organizational development theory date back to the early 1970s (e.g., the organizational life cycle model by Greiner (1972; referred to in Rozemeijer, 2008). Development models comprise parts of the body of knowledge within a wide range of other academic disciplines, like psychology, biology, economy and sociology (Rozemeijer, 2008).

Within purchasing, a relatively large body of literature now exists on development models (e.g. Reck and Long, 1988; Bhote, 1989; Freeman and Cavinato, 1990; Cammish and Keough, 1991; Keough, 1993; Burt and Doyle, 1993; Chadwick and Rajagopal, 1995; Barry et al., 1996; Schiele, 2007; van Weele, 2010⁹). It would be beyond the scope of this thesis to present and discuss all existing models; as such, we have chosen to look further into a sample of these, namely the models by Reck and Long (1988), Freeman and Cavinato (1991), Schiele (2007) and van Weele (2010). These are, with the exception of Schiele (2007), the models most frequently cited in the literature¹⁰. The model by Schiele (2007) is included to illustrate a more recent model. Table 23 constitutes our comparison of these models. Following this table, the development model by van Weele (2010) is described in more detail, to provide the reader with a fundamental understanding of the concept of purchasing development models.

⁹ This model originally stems from a 1996 conference paper by van Weele and Rozemeijer, and is included in later editions of van Weele's book “Purchasing and Supply Management”.

¹⁰ Data obtained from *Google Scholar*, 30.04.2012

PURCHASING DEVELOPMENT MODELS								
Author	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Basis for model	Empirically tested
Reck and Long (1988)	Passive	Independent	Supportive	Integrative	--	--	Interviews	No
Freeman and Cavinato (1990)	Buying (at low prices)	Purchasing	Procurement	Supply acquisition	Facilitate networks	--	Interviews	No
van Weele (2010)	Transactional orientation	Commercial orientation	Purchasing co-ordination	Process orientation	Supply chain orientation	Value chain orientation	Literature review (c.f. previous development models)	No
Schiele (2007)¹¹	Best-practice known	Person assigned to perform best-practice	Process for performing best-practice defined, documented and applied	Cross-functional integration	--	--	Previous development models	Yes

Table 23: Overview of purchasing development models

¹¹ This model consists of a total of 111 statements one must evaluate according to the four development stages; comprising a total of 444 explanatory fields

Purchasing and supply development model

The development model by van Weele (2010) takes the model by Keough (1993) as a point of departure. Keough (1993) identifies five stages of development in purchasing, and assumes a causal relationship between the industry a company operates in, and the stage of development. Van Weele (2010) combines insights from additional contributors in order to construct an integrated purchasing development model, resulting in the six-stage model depicted in Figure 27. Next, the stages in the development model by van Weele (2010) are described as by the author.

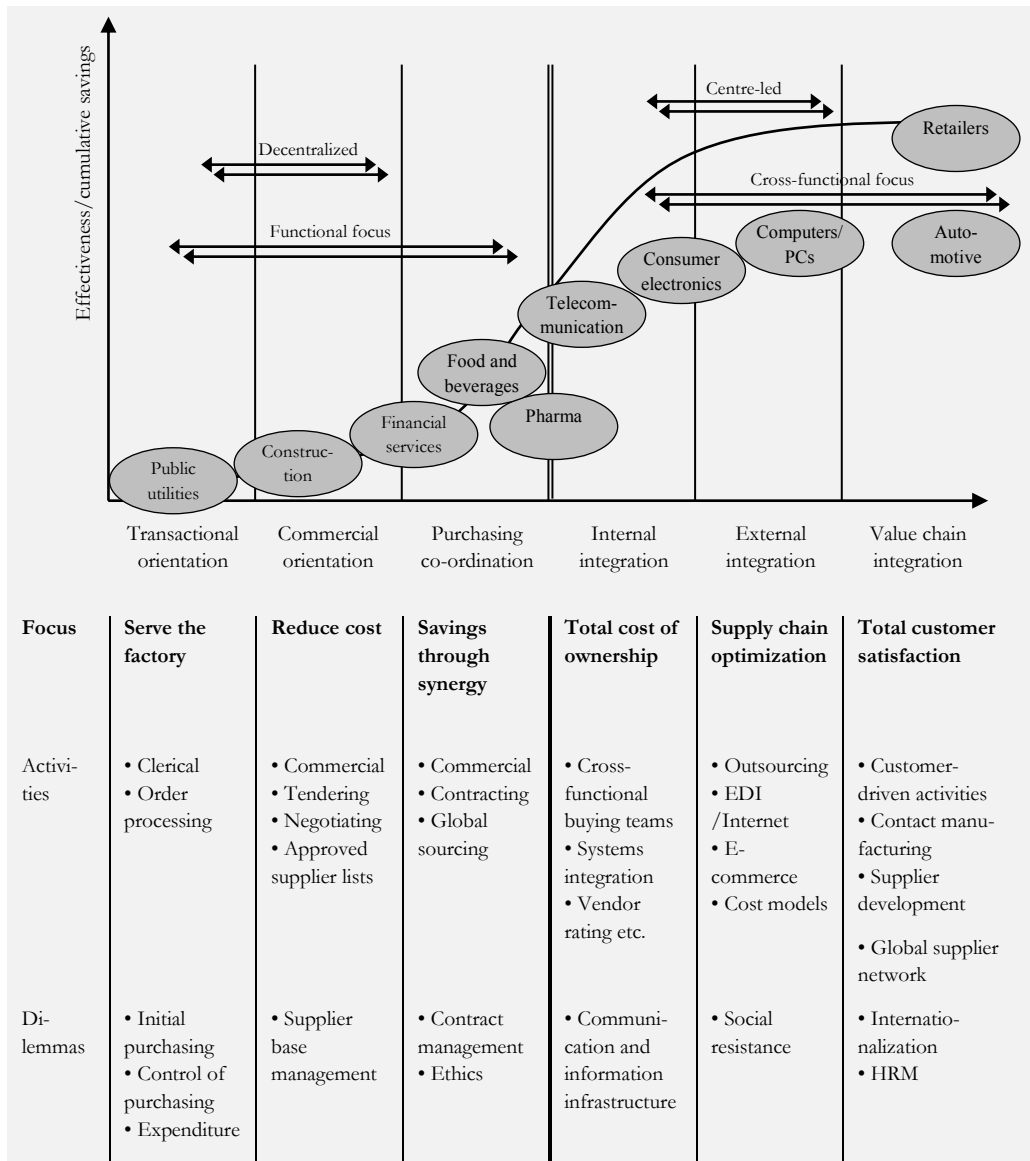


Figure 27: Purchasing and supply development model (adapted from van Weele, 2010, p.69)

In the *first stage*, purchasing's primary task is to locate appropriate suppliers and secure the supply of raw materials and necessary components. This is also regarded as the value added by the purchasing function, which lacks an explicit purchasing strategy. Purchasing is a sub-department at business unit level, and reports mostly to a production or logistics manager. It is strongly oriented on operational and administrative activities. There is very little insight in how much is spent on purchasing in the company. Buying is done reactively, and purchasing is evaluated on complaint, meaning that purchasing does a sufficient job when no complaints are filed. The purchasing staff usually consists of operational and administrative buyers with little professional purchasing education.

The *second stage* is named 'Reduce cost'; as such, the focus lies at striving for the lowest unit cost. The purchasing function is granted its own department at business unit level, and reports directly to the business unit manager. A purchasing strategy is present, focusing on low prices. Consequently, the performance of purchasing is primarily measured on cost savings, which leads to a culture showing signs of hard negotiations with many suppliers. Purchasing is increasingly becoming a specialist function. The purchasing staff consists of operational and initial buyers with hands-on experience, with specialist buyers focused around different product groups; concentrating on negotiation and contracting 'good deals'.

In the *third stage*, emphasis lies on cross-unit coordination and compliance with nationally negotiated contracts. For the first time, there is a kind of strategy formulation, which is aimed at capturing the benefits from internal coordination and synergies. The purchasing function is a centralized purchasing department at corporate level, which is responsible for establishing purchasing policies. Differentiated supplier strategies are based upon portfolio-analysis techniques. In this stage, supplier management is a focus of attention, and the firm tries to achieve purchasing power by bundling volumes across business units. Increasingly, purchasing is seen as having an important influence on the quality of the purchased products, and non-production related purchasing receives greater attention from the purchasing function. The purchasing function gets some attention from top management; however, other parts of the organization remain skeptical to whether purchasing has any real value adding potential. The purchasing organization is strongly product oriented, and the purchasing staff has purchasing background and training.

In the *fourth stage*, cross-functional problem solving receives much attention. The objective is to reduce total life cycle costs, rather than just the unit cost of purchased components. Key suppliers may be included in the problem solving, implying a move from confrontational to partnership sourcing. In the previous stages, purchasing as a function was primarily functionally oriented, with the company organized around the purchasing function; however, in this stage purchasing becomes more process-oriented, and is organized around internal customers. Non-production purchasing receives serious attention, and the purchasing function is recognized as of strategic importance; consequently, it is included in strategic issues like core/non-core and make-or-buy decisions. The structure is 'center-led', meaning that cross-functional (or cross-business) teams conduct coordination activities with active support of the business units under strong management by a corporate purchasing staff. With respect to the framework by

Rozemeijer et al. (2003) (Figure 25), this refers to a situation with both high corporate coherence and high purchasing maturity. Operational buying receives less attention, as e-procurement solutions are put in place to handle this. The purchasing staff is highly educated with a broad business perspective.

The *fifth stage* has a focus on outsourcing, for which a dedicated strategy is formulated; focusing on creating maximum leverage of the company's external resources. This is combined with an attention to collaborate with supply chain partners, especially suppliers, in new product development, pre-production planning activities and process improvements. Non-production buying is executed or fully supported by the purchasing function, and ease for internal customers is pursued through systems contracting, electronic business, catalogues or electronic data interchange (EDI). In this stage, supplier management becomes supply chain management; instead of having mere transactional relationships to suppliers, the firm now invests in supply partners. Initial purchasing is no longer performed by a separate department, but rather by cross-functional teams. The suppliers may have representatives in the buying firm to work on design or manufacturing problems, constituting so called residential engineering teams. There is integration across disciplines, divisions and suppliers, in order to achieve integrated supply chain management. This is supported by information systems that are integrated internally as well as with partner suppliers. Important skills are knowledge of principles underlying total cost of ownership (TCO), e.g. being able to build cost models, strategic supply chain management and general management skills.

In the *sixth and final stage* of the development model by van Weele (2010), delivering value to the end customer is at the center of attention in the purchasing strategy. As such, suppliers are challenged to support the firm's market strategies, and participate actively in product development. The value chain orientation has the goal of designing the most effective and efficient value chain possible. Instead of just contributing to the bottom line in terms of cost reduction, suppliers are challenged to contribute to the top line through business development. There is a strategic fit between the overall business strategy and the purchasing strategy. The traditional marketing and purchasing functions are integrated, and all organizational members carry a shared, entrepreneurial vision.

As development models are not without critics, we have chosen to look further into some of the critique on purchasing development models in the succeeding section.

4.2.2 Critique of purchasing development models

Purchasing development models are both questioned and criticized. Dubois and Wynstra (2005) discuss the model by van Weele (2005)¹². They point out that one could question why one phase should be considered more advanced and sophisticated than the other. The authors argue that a purchasing function could do a good job in terms of performance, even though it does not operate at the highest possible level of sophistication. They point out that in specific cases, like in small firms, this may be the case; the higher skills and concomitant high salaries, together with

¹² Previous edition of van Weele (2010)

expensive supporting technologies that may come with higher levels of sophistication, may be a too high price to pay compared with the potential improvements (Dubois and Wynstra, 2005).

Ramsay and Croom (2008) follow in the lines of the critique mentioned above, and criticize the widespread consensus that has emerged in the Purchasing and Supply Management (PSM) field – that purchasing and supply activities may be classified as “strategic” and “nonstrategic”. In this respect, they criticize development models, which imply that intra-organizational status can be improved by “moving up the evolutionary ladder” (p.198), away from administrative or clerical activities: “At the heart of the conventional wisdom lies the argument that some PSM activities are intrinsically non-strategic and that because improvements in the function’s strategic contribution will enable the function to improve its intra-organisational status, it should focus on strategic activities” (p.203). According to Ramsay and Croom (2008), this will only apply after you have established the organizational value of the function by dramatically demonstrating the contribution of PSM activities to the firm’ bottom line. A failure to do this may be a cause of continued low status in large companies (Ramsay and Croom, 2008). The authors point out that they do not suggest that the purchasing function should become passive and clerical; however, in firms where no purchasing function does not yet exist, or is small and struggling against maverick purchasing activities, “getting control of the ‘low-level’ clerical activities is an essential objective” (p.203). As such, the authors claim that purchasing development models are unhelpful.

Rozemeijer (2008) responds to the article by Ramsay and Croom (2008). He agrees with Ramsay and Croom (2008) in that purchasing development model literature typically lacks the notion that purchasing development models are not substitutes for various degrees of strategic thinking, influencing and problem solving that exist in unique firms. However, Rozemeijer (2008) disagrees with respect to develop models being unhelpful. According to him, development models are helpful in classifying organizations in terms of their current position. Further, they are especially relevant when one in a systematic way wants to take bearing of possible directions for strategic change (Rozemeijer, 2008). The author provides several questions which such a model can help answer: “What should the next growth step be given the specific industry and company context? How could a firm develop from stage 1 to 2 or from 4 to 5? What measures need to be taken? What barriers need to be overcome? What potential improvements are to be harvested?” (p.206).

Dubois and Wynstra (2005) question whether there is a natural growth path from left to right, and argue that organizations may revert one or several phases. This is also acknowledged by Reck and Long (1988), who claim that “the purchasing function appears to move up and down the development continuum” (p.8). Other similar development issues are addressed by van Weele (2010), who poses several questions related to the development path: “Does purchasing development really take place as a process of continuous change or is it in reality characterized more by step-changes and discontinuity?”; “do all organizations follow the stages identified or can some stages be skipped?”; “how much time does it take to go through the different stages of the model?”; “is it possible to skip some stages in the model?” (p.72).

Van Weele (2010) acknowledges that his development model has never been empirically tested through academic research, and as such he cannot provide any answers to the questions above. Ramsay and Croom (2008) note that “no empirical evidence is offered in any of the papers employing the biological metaphors to show that all purchasing functions are improving” (p.199). This lack of empirical testing is recognized by Rozemeijer (2008) as the most important drawback of purchasing development models. He notes that the papers and books from which these models are derived are conceptual and based on literature studies; as such, they should be regarded as conceptual, even though they have been utilized as instruments for diagnosis by many consultants and practitioners (Rozemeijer, 2008).

Table 24 summarizes the identified critique on purchasing development models. In the next section, a discussion on the preceding findings is given.

CRITIQUE ON PURCHASING DEVELOPMENT MODELS	
Critique	Author(s)
Over-emphasis on the rightmost stages of the models – neglecting the bottom line impact of “non-strategic” items and uniqueness of firms that may impede the development process.	Dubois and Wynstra (2005); Ramsay and Croom (2008)
Questionable whether firms follow a linear development path from “left to right”	Reck and Long (1988); Dubois and Wynstra (2005); Van Weele (2010)
Lack of empirical testing, questionable validity and reliability of such models	Rozemeijer (2008); Van Weele (2010)

Table 24: Critique on purchasing development models

4.3 Discussion

In this chapter, we have reviewed literature on purchasing sophistication, and the closely related concept of purchasing development models, including critique of the latter. We see it beneficial to discuss these findings, in order to establish which findings that will be brought along to the establishment of a theoretical framework at the end of this part, answering our first research question (1.2). First, we discuss definitions and characteristics of purchasing sophistication. Thereafter, we investigate *how* purchasing sophistication may relate to purchasing development models, by comparing characteristics of the first with an example of the latter. Finally, we discuss how critique on purchasing development models may apply for purchasing sophistication.

4.3.1 Adopting a definition and characteristics of purchasing sophistication

As previously mentioned, there is little consensus on the definition of purchasing sophistication (4.1). Pearson and Gritzmacher (1990) are the only authors to give an explicit definition of purchasing sophistication; “the sophistication level of purchasing within an organization

determines to a great extent its role in and integration into the strategic management decision making process” (p.93) (4.1.2). According to Rozemeijer et al. (2003), purchasing maturity reflects the level of professionalism in the purchasing function (4.1.3). This definition is adopted by Gelderman and van Weele (2005), who define purchasing sophistication as “the level of professionalism of the purchasing function” (p.22), and equate sophistication and maturity (4.1.4). Schiele (2007) further defines maturity as the development level of a purchasing organization (4.1.5). As such, we note that purchasing sophistication, professionalism and maturity are somewhat used interchangeably to display the same term. Neither Rozemeijer et al. (2003), Gelderman and van Weele (2005) nor Schiele (2007) define what is meant by level of professionalism or development level of the purchasing function; nor do Guinipero and Zenz (1982) and Kraljic (1983) with respect to the extent of professionalism in the purchasing function and stages of purchasing sophistication, respectively. As such, the definition of purchasing sophistication by Pearson and Gritzmacher (1990) seems appropriate to adopt throughout this master’s thesis.

When reviewing the literature, we saw that the foci in the respective articles reflect the development in purchasing’s strategic relevance (as described in 1.1.4). The earlier articles (Guinipero and Zenz, 1982; Kraljic, 1983) reflect that purchasing had not yet received recognition as an important strategic function. Furthermore, the more recent articles (Pearson and Gritzmacher, 1990; Rozemeijer et al., 2003; Gelderman and van Weele, 2005; Schiele, 2007) have acknowledged the importance of the purchasing function, both as a contributor to strategic planning and economic performance (1.1.4). In line with this development in literature, we see a change in foci of analysis when considering purchasing sophistication; from the individual (Guinipero and Zenz, 1982), via product level (Kraljic, 1983) to the purchasing function (Pearson and Gritzmacher, 1990; Rozemeijer et al., 2003; Gelderman and van Weele, 2005; Schiele, 2007).

We argue that a comprehensive understanding of purchasing sophistication also should include recommendations as to how to achieve, or, in other words, prerequisites for purchasing sophistication. As such, only two of the identified articles (Pearson and Gritzmacher, 1990; Gelderman and van Weele, 2005) meet this criterion (Table 22). When comparing these two contributions, we see some resemblance in the definitions. To recapitulate, Gelderman and van Weele (2005) provide the following characteristics of purchasing sophistication: reporting level; contribution to competitive position; orientation on collaboration; cross-functional teams; developing strategies; and, clerical activities. When comparing these with the characteristics provided by Pearson and Gritzmacher (1990), we see that many characteristics are defined in a similar manner. Reporting level bears resemblance to *organizational structure*, as it reflects purchasing reporting to top management. Further, orientation on collaboration is defined in a similar manner as *supplier network and relationships*; oriented on collaborative relationships with (fewer) suppliers. Contribution to competitive position is reflected in *strategic management*; both refer to purchasing’s contribution to corporate competitive strategy. Clerical activities are defined in terms of low sophistication; hence, it reflects the operational approach’s description of *organizational perceptions*. It is likely that non-clerical activities would result in a higher

organization perception of the purchasing function, and as such, we argue that these characteristics are similar.

Developing strategies and *decision issues* are somewhat less similar than the previously discussed characteristics. Developing strategies has a more strategic focus than the more operational decision issues. Further, we see that the *information access* and *information technology* characteristics by Pearson and Gritzmacher (1990) are not incorporated in the characteristics by Gelderman and van Weele (2005). We do, however, argue that these characteristics are somewhat self-evident in these days; reflecting that these characteristics may be somewhat outdated. Finally, Gelderman and van Weele (2005) incorporate cross-functional teams as a prerequisite for high purchasing sophistication, which reflects today's trend of teaming.

Based on this discussion, we argue that the characteristics given by Gelderman and van Weele (2005) are the most comprehensive, and incorporate characteristics provided by other authors. Even though not all characteristics are incorporated, we argue that the few remaining characteristics are redundant in today's marketplace. They further provide cross-functional teamwork as a characteristic determining purchasing sophistication. We consider this valuable, as it also reflects important trends in both literature and business practice. In addition, we note that the characteristics have been operationalized in a survey conducted by the authors, in a study with similar research objectives as in this master's thesis. As such, by approaching a consensus by adopting these characteristics, we see the possibility to replicate the study and do comparisons with purchasing practice in Norwegian ETO companies.

4.3.2 Investigating the relationship between purchasing sophistication and purchasing development models

As seen in 4.1, several authors (Rozemeijer et al., 2003; Gelderman and van Weele, 2005; Schiele, 2007) have developed their characteristics of purchasing sophistication from purchasing development models. As mentioned in the proceeding subsection, Pearson and Gritzmacher (1990) and Gelderman and van Weele (2005) are the only ones to provide what we have termed prerequisites for (high) sophistication (Table 22). They do not, however, distinguish between various *levels* of sophistication beyond pointing to what is non-sophisticated (operational) and what is sophisticated (strategic). Pearson and Gritzmacher (1990) explicitly call for future studies on how to measure a firm's level of purchasing sophistication (4.1.2).

In the section concerning purchasing development models (4.2), a development model was defined as a model that “describes several – auditable – stages an organization is expected to go through in its quest for greater sophistication” (Schiele, 2007, p.274). Rozemeijer (2008) argues that development models are helpful in classifying organizations in terms of their current position, and in a systematic way providing possible directions for strategic change (4.2.2). As such, we see it beneficial to compare purchasing sophistication characteristics with a development model, in order to distinguish whether such a model reflect various levels of purchasing sophistication per se. The choice of a development model, to use as a framework in this discussion, is described in the next paragraph.

The choice of purchasing development model

The development models by Reck and Long (1988), Cavinato and Freeman (1990), van Weele (2010) and Schiele (2007) were compared in 4.2.1. These vary with, among others, number of stages, basis for the model and empirical foundation (Table 23). The models by Reck and Long (1988) and Freeman and Cavinato (1990) illustrate how purchasing can evolve from a clerical function to a strategic contributor, while the models by van Weele (2010) and Schiele (2007) go further in describing how the function can evolve after it is regarded as of strategic importance. As such, the various models reflect the evolution of purchasing's strategic importance, as outlined in the introduction (1.1.4). As purchasing today generally is regarded to be of strategic importance (1.1.4), we feel that the models by van Weele (2010) and Schiele (2007) best reflect today's situation.

The model by Schiele (2007) is regarded to be too comprehensive for our purpose, as it consists of a total of 111 statements one must evaluate according to four development stages; comprising a total of 444 explanatory fields (Table 23; ¹¹). Therefore, we choose the development model by van Weele (2010) as a starting point. This is also the model with the highest number of development stages (Table 23); hence, we regard it to be the most nuanced – which intuitively seems beneficial in comparing purchasing sophistication characteristics. The model by van Weele (2010) also integrates and combines insight from other development models (4.2.1), which speaks in its favor when choosing between the models. In line with the discussion in 4.3.1, the purchasing sophistication characteristics by Gelderman and van Weele (2005) are compared with the development model by van Weele (2010) in the next paragraph.

Comparing purchasing sophistication characteristics with a purchasing development model

The development model by van Weele (2010) does not explicitly use purchasing sophistication at the horizontal axis; it uses time (Figure 27). As such, we will in this paragraph discuss whether the time dimension could be replaced by level of purchasing sophistication. Consequently, in order to relate the development model to purchasing sophistication, we compare each stage to the purchasing sophistication characteristics provided by Gelderman and van Weele (2005): reporting level; contribution to competitive position; orientation on collaboration; cross-functional teams; developing strategies; and, clerical activities (4.1.4; Table 21). In our understanding of the development model, we argue that favorable acquired skills or characteristics do not expire in the evolution from left to right; e.g., when the purchasing function does not receive *less* attention from top management when evolving. The discussion of each stage follows below.

Stage 1		
Characteristics of purchasing sophistication (Gelderman and van Weele; 4.1.4, Table 21)	Description of characteristic (Gelderman and van Weele; 4.1.4, Table 21)	Description of stage in the development model (Weele, 2010; 4.2.1)
Reporting level	A highly sophisticated purchasing function would report directly to top management, whereas a firm with a low level of sophistication would have a lengthy reporting chain.	Purchasing mostly reports to a production or logistics manager.
Contribution to competitive position	A sophisticated purchasing function, in contrast to an immature function, will be considered as an important resource for the firm	Securing supply is regarded as the value added by the purchasing function.
Orientation on collaboration	A sophisticated purchasing function should have an orientation toward collaborative relationships with suppliers	Purchasing's primary task is to locate appropriate suppliers and secure the supply of raw materials and necessary components.
Cross-functional teams	The skills to participate in cross-functional teams are likely to be associated with the purchasing sophistication of companies.	Cross-functional teams are not mentioned at this stage in the model.
Developing strategies	Purchasing personnel in companies with a more sophisticated approach to purchasing will have the skills to develop differentiated purchasing and supplier strategies.	The purchasing staff usually consists of operational and administrative buyers with little professional purchasing education.
Clerical activities	Buyers in a non-sophisticated purchasing function solve day-to-day problems with suppliers and spend their time mainly on clerical and administrative tasks.	Buying is done reactively, locate appropriate suppliers and secure supply.
Evaluation		The only characteristic of purchasing sophistication that coincides with stage 1 is that buying is done reactively, with location of appropriate suppliers and securing of supply. This is a characteristic of a non-sophisticated purchasing function.

Table 25: Comparison of sophistication and development; Stage 1

As shown in Table 25, only one characteristic of purchasing sophistication is recognized in stage 1; clerical activities. This is, however, described as an indicator of a non-sophisticated purchasing function. As such, the level of purchasing sophistication is low in stage 1.

Stage 2		
Characteristics of purchasing sophistication (Gelderman and van Weele; 4.1.4, Table 21)	Description of characteristic (Gelderman and van Weele; 4.1.4, Table 21)	Description of stage in the development model (Weele, 2010; 4.2.1)
Reporting level	A highly sophisticated purchasing function would report directly to top management, whereas a firm with a low level of sophistication would have a lengthy reporting chain.	The purchasing function at business unit level reports directly to the business unit manager.
Contribution to competitive position	A sophisticated purchasing function, in contrast to an immature function, will be considered as an important resource for the firm	The performance of purchasing is primarily measured on cost savings.
Orientation on collaboration	A sophisticated purchasing function should have an orientation toward collaborative relationships with suppliers	The culture is playing hard negotiations with many suppliers.
Cross-functional teams	The skills to participate in cross-functional teams are likely to be associated with the purchasing sophistication of companies.	Cross-functional teams are not mentioned at this stage in the model.
Developing strategies	Purchasing personnel in companies with a more sophisticated approach to purchasing will have the skills to develop differentiated purchasing and supplier strategies.	Purchasing strategy characterized by a focus on low prices. Purchasing staff consisting of operational and initial buyers with hands-on experience.
Clerical activities	Buyers in a non-sophisticated purchasing function solve day-to-day problems with suppliers and spend their time mainly on clerical and administrative tasks.	Specialist buyers focused around different product groups, concentrating on negotiating and contracting 'good deals'.
Evaluation		Instead of doing merely clerical and administrative tasks, specialist buyers are now focused around different product groups, concentrating on negotiating and contracting.

Table 26: Comparison of sophistication and development; Stage 2

In stage 2, the same characteristic of purchasing sophistication as identified in stage 1 appears; however, now, specialist buyers are focused on product groups with more comprehensive tasks. As such, the level of purchasing sophistication is slightly higher in stage 2 than in stage 1.

Stage 3		
Characteristics of purchasing sophistication (Gelderman and van Weele; 4.1.4, Table 21)	Description of characteristic (Gelderman and van Weele; 4.1.4, Table 21)	Description of stage in the development model (Weele, 2010; 4.2.1)
Reporting level	A highly sophisticated purchasing function would report directly to top management, whereas a firm with a low level of sophistication would have a lengthy reporting chain.	Gets some attention from top management.
Contribution to competitive position	A sophisticated purchasing function, in contrast to an immature function, will be considered as an important resource for the firm	Increasingly, purchasing is seen as having an important influence on the quality of the purchased products. Parts of the organization remain skeptical to whether purchasing has any real value adding potential.
Orientation on collaboration	A sophisticated purchasing function should have an orientation toward collaborative relationships with suppliers	Supplier management is a focus of attention, and the firm tries to achieve purchasing power by bundling volumes across business units.
Cross-functional teams	The skills to participate in cross-functional teams are likely to be associated with the purchasing sophistication of companies.	Cross-functional teams are not mentioned at this stage in the model.
Developing strategies	Purchasing personnel in companies with a more sophisticated approach to purchasing will have the skills to develop differentiated purchasing and supplier strategies.	For the first time there is a kind of strategy formulation, which is aimed at capturing the benefits from internal coordination and synergies. Differentiated supplier strategies are based upon portfolio-analysis techniques.
Clerical activities	Buyers in a non-sophisticated purchasing function solve day-to-day problems with suppliers and spend their time mainly on clerical and administrative tasks.	Supplier management is a focus of attention. The purchasing organization is strongly product oriented, and the purchasing staff has purchasing background and training.
	Evaluation	In this stage, two of the six characteristics of purchasing sophistication are recognized. Top level reporting is not included in this, as “some attention from top management” must be said to differ from reporting directly to it. The same type of argument excludes the second characteristic, as parts of the organization question the importance of purchasing (even though its impact of quality is recognized). With differentiated supplier strategies and purchasing strategy formulation, it must be assumed that the skills required to shape such strategies are present. Further, supplier management is presumably too comprehensive to be classified as clerical and administrative activities.

Table 27: Comparison of sophistication and development; Stage 3

In stage 3, two of the characteristics coincide with the development model. As differentiated supplier strategies and purchasing strategy formulation are present, we argue that skills to shape such strategies are most likely present. Further, the tasks performed by the purchasing function have evolved into supplier management.

Stage 4		
Characteristics of purchasing sophistication (Gelderman and van Weele; 4.1.4, Table 21)	Description of characteristic (Gelderman and van Weele; 4.1.4, Table 21)	Description of stage in the development model (Weele, 2010; 4.2.1)
Reporting level	A highly sophisticated purchasing function would report directly to top management, whereas a firm with a low level of sophistication would have a lengthy reporting chain.	Presumably reporting directly to top level
Contribution to competitive position	A sophisticated purchasing function, in contrast to an immature function, will be considered as an important resource for the firm	The purchasing function is recognized as of strategic importance.
Orientation on collaboration	A sophisticated purchasing function should have an orientation toward collaborative relationships with suppliers	Key suppliers may be included in the problem solving, implying a move from confrontational to partnership sourcing.
Cross-functional teams	The skills to participate in cross-functional teams are likely to be associated with the purchasing sophistication of companies.	Cross-functional problem solving receives much attention. Cross-functional (or cross-business) teams conduct coordination activities with active support of the business units under strong management by a corporate purchasing staff.
Developing strategies	Purchasing personnel in companies with a more sophisticated approach to purchasing will have the skills to develop differentiated purchasing and supplier strategies.	The purchasing staff is highly educated with a broad business perspective.
Clerical activities	Buyers in a non-sophisticated purchasing function solve day-to-day problems with suppliers and spend their time mainly on clerical and administrative tasks.	Purchasing is involved in strategic issues like core/non-core and make-or-buy decisions. Operational buying disappears in the line; it is integrated with materials planning.
Evaluation		All characteristics of purchasing sophistication are identified.

Table 28: Comparison of sophistication and development; Stage 4

In stage 4, all characteristics of purchasing sophistication are present. In this stage, purchasing is regarded as of strategic importance, which also coincides with the last step in the models by Reck and Long (1988) and Freeman and Cavinato (1990). The development model by van Weele

(2010) does, however, go further with two additional steps. As shown in Table 29 and Table 30 below, all six characteristics of purchasing sophistication can also be identified, or else assumed to be present due to the preceding steps, in these steps.

Stage 5		
Characteristics of purchasing sophistication (Gelderman and van Weele; 4.1.4, Table 21)	Description of characteristic (Gelderman and van Weele; 4.1.4, Table 21)	Description of stage in the development model (Weele, 2010; 4.2.1)
Reporting level	A highly sophisticated purchasing function would report directly to top management, whereas a firm with a low level of sophistication would have a lengthy reporting chain.	Presumably reporting directly to top level
Contribution to competitive position	A sophisticated purchasing function, in contrast to an immature function, will be considered as an important resource for the firm	Presumably important, as the purchasing function concentrates on creating maximum leverage of the company's external resources through a focus on outsourcing, for which a dedicated strategy is formulated.
Orientation on collaboration	A sophisticated purchasing function should have an orientation toward collaborative relationships with suppliers	Increased attention to collaborate with supply chain partners, especially suppliers, in new product development and, pre-production planning activities and process improvements. Supplier management becomes supply chain management; instead of having mere transactional relationships to suppliers, the firm now invests in supply partners.
Cross-functional teams	The skills to participate in cross-functional teams are likely to be associated with the purchasing sophistication of companies.	Initial purchasing is no longer performed by a separate department, but rather by cross-functional teams. There is integration across disciplines, divisions and suppliers in order to achieve integrated supply chain management.
Developing strategies	Purchasing personnel in companies with a more sophisticated approach to purchasing will have the skills to develop differentiated purchasing and supplier strategies.	Important skills are knowledge of TCO principles; e.g. building cost models, strategic supply chain management and general management skills.
Clerical activities	Buyers in a non-sophisticated purchasing function solve day-to-day problems with suppliers and spend their time mainly on clerical and administrative tasks.	The sum of the above clearly deviates from clerical, administrative tasks.
Evaluation		All characteristics of purchasing sophistication are identified.

Table 29: Comparison of sophistication and development; Stage 5

Stage 6		
Characteristics of purchasing sophistication (Gelderman and van Weele; 4.1.4, Table 21)	Description of characteristic (Gelderman and van Weele; 4.1.4, Table 21)	Description of stage in the development model (Weele, 2010; 4.2.1)
Reporting level	A highly sophisticated purchasing function would report directly to top management, whereas a firm with a low level of sophistication would have a lengthy reporting chain.	Presumably reporting directly to top level
Contribution to competitive position	A sophisticated purchasing function, in contrast to an immature function, will be considered as an important resource for the firm	The overall business strategy reflects in the purchasing strategy.
Orientation on collaboration	A sophisticated purchasing function should have an orientation toward collaborative relationships with suppliers	Suppliers are challenged to support the firm's market strategies, and participate actively in product development. Instead of just contributing to the bottom line in terms of cost reduction, suppliers are encouraged to contribute to the top line through business development.
Cross-functional teams	The skills to participate in cross-functional teams are likely to be associated with the purchasing sophistication of companies.	The traditional marketing and purchasing functions are integrated, and all organizational members carry a shared, entrepreneurial vision.
Developing strategies	Purchasing personnel in companies with a more sophisticated approach to purchasing will have the skills to develop differentiated purchasing and supplier strategies.	Given the preceding five steps, the purchasing personnel must be assumed to possess sufficient skills to develop such strategies.
Clerical activities	Buyers in a non-sophisticated purchasing function solve day-to-day problems with suppliers and spend their time mainly on clerical and administrative tasks.	The sum of the above, and the preceding steps, clearly deviates from clerical, administrative tasks.
	Evaluation	All characteristics of purchasing sophistication are identified.

Table 30: Comparison of sophistication and development; Stage 6

To summarize, the level of purchasing sophistication is increasing from stage 1 to stage 4. The purchasing sophistication characteristics cannot be used to distinguish between stage 4 and the final two stages. This may be explained by the definition of purchasing sophistication; “the sophistication level of purchasing within an organization determines to a great extent its role in and integration into the strategic management decision making process” (Pearson and Gritzmacher, 1990, p.93; 4.1.2). As seen in the development model by van Weele (2010), the

purchasing function is recognized as a strategic contributor in stage 4. This is also the final stages of the models by Reck and Long (1988) and Freeman and Cavinato (1990). As such, we have reached the highest level of purchasing sophistication, as characterized by Gelderman and van Weele (2005), already in stage 4.

In conclusion, we argue that the different stages of the development model reflect different levels of purchasing sophistication. As such, the different stages' descriptions may arguably be used to diagnose a company's level of purchasing sophistication. In the next subsection, we discuss how critique on purchasing development model relates to purchasing sophistication.

4.3.3 Applying critique of purchasing development models to purchasing sophistication

In 4.2.2, we identified critique on purchasing development models. The critique on purchasing development models is about over-emphasis on the rightmost stages of the models, uncertainty concerning the evolutionary path and lack of empirical testing (4.2.2; Table 24). In this subsection, we discuss whether this critique applies for purchasing sophistication.

With respect to the over-emphasis on the rightmost stages, Dubois and Wynstra (2005) question why one phase should be considered more advanced and sophisticated than the other; arguing that a purchasing function could perform well, despite operating at a lower level of sophistication. With respect to the first part of this argument, we have in the proceeding subsection shown an increase in sophistication when moving through the stages, using the characteristics of sophistication by Gelderman and van Weele (2005). With respect to the latter part of the argument, Dubois and Wynstra (2005) argue that in specific cases, costs associated with higher levels of sophistication may be a too high price to pay, compared with the potential improvements. This corresponds with the lower left area in the minimum maturity point illustration by Schiele (2007) (4.1.5; Figure 26). In line with this, Ramsay and Croom (2008) argue that in firms where a purchasing function do not exist, or where they are struggling against maverick purchasing activities, it is essential to get control of the clerical activities. We agree that it may not necessarily be beneficial to strive for the highest possible level of purchasing sophistication, when the basics are still critical. However, Schiele (2007) notes that a purchasing function is prone to having a minimum maturity point, below which the implementation of best-practice would defeat its own end. As such, we argue that a purchasing function needs a sufficient level of sophistication to utilize tools that may bring advantage, both with respect to strategic congruence and economics.

Several authors (Reck and Long , 1988; Dubois and Wynstra, 2005; van Weele, 2010) question whether there is an evolutionary growth path from left to right, if a company may reside in more than one stage, and so on (4.2.2). One can argue that this critique also applies for purchasing sophistication: is it necessarily the case that a company possesses all characteristics of purchasing sophistication; is it possible to acquire a characteristic, for later to lose it? The identified theory on purchasing sophistication does not answer such questions, and we see that empirical testing is necessary. This lack of empirical testing is also the last identified critique on purchasing

development models (4.2.2); as such, we see that the critique applies. In the next section, we conclude on which findings to bring along to the theoretical framework at the end of this part.

4.4 Towards the theoretical framework – Purchasing sophistication

The main purpose of this chapter has been to provide a necessary understanding of the concept of purchasing sophistication. Several central topics related to the concept have been presented. We will now gather and classify findings that will be brought along to the construction of a theoretical framework at the end of this part. These findings will, as for purchasing portfolio approaches (chapter 3), subsequently be used; both for answering RQ1 and structuring and guiding the analysis. In the analysis (chapter 8), these findings will be refined using empirical data gathered through our mixed methods research, c.f. 2.1.3.

The first relevant finding to be included in the theoretical framework is the definition of the concept of purchasing sophistication. As described in 4.3.1, we adopt the definition by Pearson and Gritzmacher (1990, p.93); “the sophistication level of purchasing within an organization determines to a great extent its role in and integration into the strategic management decision making process”. Further, we adopt the characteristics of purchasing sophistication provided by Gelderman and van Weele (2005) (4.1.4; Table 21). As such, these characteristics will be brought along to the theoretical framework. Moreover, the discussion by Schiele (2007) concerning the minimum maturity point (4.1.5) is intuitively regarded relevant; hence, it the concept of a minimum maturity point is included in the theoretical framework.

Further, we have compared several purchasing development models (Reck and Long, 1988; Freeman and Cavinato, 1990; van Weele, 2010; Schiele, 2007). Based on the discussion of these models (4.3.2), we adopt the model by van Weele (2010), and include the concept of purchasing development models in the theoretical framework. Finally, we have elucidated critique on purchasing development models (4.2.2), and further discussed this in relation to purchasing sophistication (4.3.3). As such, the topic of critique is included in the framework. In summary, the findings to be brought along to the development of a theoretical framework are illustrated in Figure 28 below.

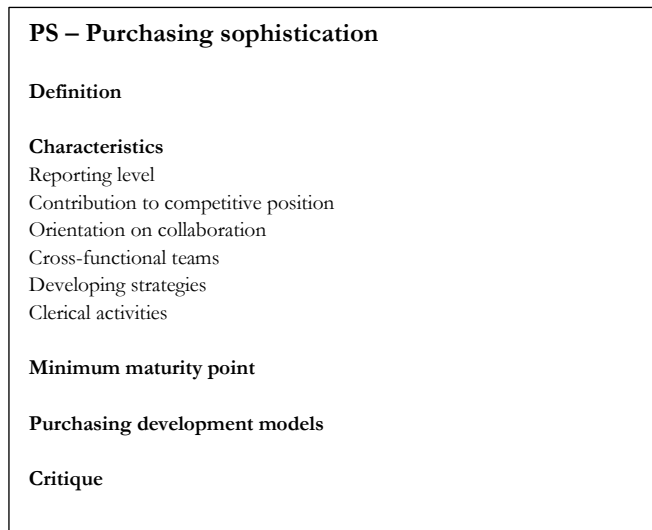


Figure 28: Findings from PS brought along to the theoretical framework

5 Engineer-to-order

The purpose of this chapter is to gain a fundamental understanding of the engineer-to-order (ETO) production situation. We first present a discussion on different production situations and taxonomies, before we review characteristics of ETO companies. A need for cross-functional integration in ETO companies is then described, followed by a presentation of literature on purchasing practices in ETO companies. Thereafter, we summarize the findings that will be brought along to the theoretical framework.

5.1 ETO as a production situation

Many classifications have been made with the purpose to distinguish between different production situations (Bertrand and Muntslag, 1993). In his development of a typology, Wortmann (1992) claims that the notion of the customer order decoupling point (CODP) must be introduced beforehand. The CODP (also referred to as the order penetration point (OPP) (Olhager, 2003) or customer order point (COP) (Olhager and Östlund, 1990)) is the point in time where the production goes from being forecast driven to demand driven, i.e. the point where customer-order driven activities take place (e.g. Wortmann, 1992; Wikner and Rudberg, 2005; Olhager, 2003; 2010; Olhager and Östlund, 1990). Different positions of the CODP give rise to different production situations; they relate to the timing of the customer order, and the post-order actions taken.

Most of the operations management and production literature would classify companies into a manufacturing continuum spanning across four types: make-to-stock (MTS); assemble-to-order (ATO); make-to-order (MTO); and engineer-to-order (ETO) (Amaro et al., 1999). Several authors depict this (e.g. Wortmann, 1992; Giesberts and van der Tang, 1992, Olhager, 2003), and the illustration by Olhager (2003) is chosen to demonstrate it (Figure 29):

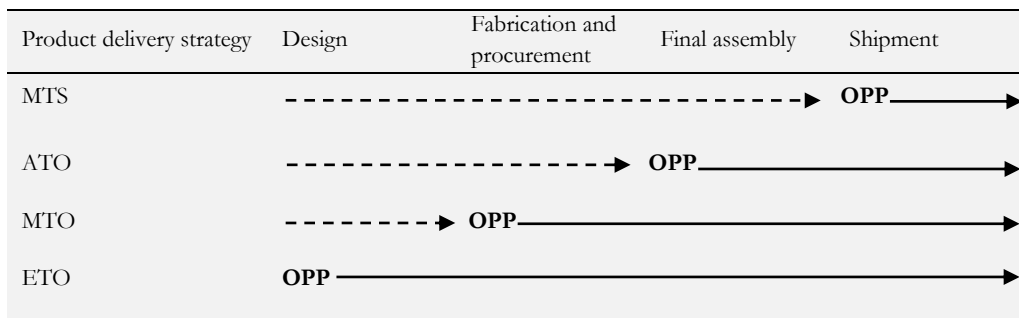


Figure 29: Production situations and the order penetration point.

Dotted lines means forecast-driven, straight lines means customer-order-driven (Olhager, 2003, p.320)

There are numerous ways of wording the description of these production situations. However, the underlying message seems to be consistent, illustrated by two examples (Table 31):

Production situation	Amaro et al. (1999)	Bertrand and Muntslag (1993) (use the classification of Sari (1981))
MTS	<i>N/A (The article looks at non-MTS)</i>	Converts lower-level components and raw materials all the way to end-items in anticipation of customer orders
ATO	The final products offered to customers, although presenting some degree of customisation, are produced with (common) standardised parts, which can be assembled in a number of different options. The receipt of an order initiates the assembly of the particular finished product that meets customer requirements. The component parts used in the assembly or finishing process, whether purchased or fabricated internally, are planned and stocked in anticipation of future customer orders.	Converts lower-level components and raw materials to a predetermined level of manufacture, and configures to customer order upon receipt of a customer order
MTO	Most or all the operations necessary to manufacture each specific product are only done after the receipt of a customer order. In some situations even materials and component parts may have to be procured on the receipt of a particular order. The capability for product customisation is greater than in ATO producers.	Obtains very few, perhaps no lower-level materials until after receipt of a customer order
ETO	Products are manufactured to meet a specific customer's needs and so require unique engineering design or significant customisation. Thus, each customer order results in a unique set of part numbers, bill of material, and routing.	Knows very little about what to order or manufacture until after receipt of a customer order and development of engineering specifications

Table 31: The four “classic” production situations

As can be seen from Table 31, the different production situations all relate to the timing of the customer order, and the post-order actions taken.

5.1.1 A variety of taxonomies

In addition to the production situations mentioned above, reviewing the literature has put forth numerous several other taxonomies. These are summarized in Table 32.

Taxonomy	Author(s)	Comment
Make-to-stock (MTS) Assemble-to-order (ATO) Make-to-order (MTO) Engineer-to-order (ETO)	(e.g.) Wortmann (1992); Sari (1981), referred to in Bertrand and Muntslag (1993); Amaro et al. (1999); Olhager (2003)	Most operations management literature would classify companies into MTS, ATO, MTO and ETO (Amaro et al., 1999)
Design-to-order (DTO)	Porter et al. (1999); Hill (1993); Stavrulaki and Davis (2010)	Porter et al. (1999) and Hill (1993) add DTO to MTS, ATO, MTO and ETO. Stavrulaki and Davis (2010) refer to DTO with respect to ETO
Make-to-print (MTP)	Hill (1993)	Adds MTP to MTS, ATO, MTO, ETO and DTO (see above).
Build-to-order (BTO)	Holweg and Pil (2001); Krajewski et al. (2005); Fredriksson and Gadde (2005); Gunasekaran and Ngai (2005)	Gunasekaran and Ngai (2005) argue that BTO often is understood to be similar to MTO; however, they argue that lead times are longer in MTO than in BTO. Further, components and parts are made and then assembled in MTO, whereas the components and parts are ready for assembly in BTO (Gunasekaran and Ngai, 2005).
Assemble-to-stock (ATS) Build-to-forecast (BTF) Engineer-to-stock (ETS) Configure-to-order (CTO)	Gunasekaran and Ngai (2005)	BTF is similar to MTS and ATS whereas CTO is similar to ETS (Gunasekaran and Ngai, 2005).
Buy-to-order (BTO) Ship-to-stock (STS)	Gosling and Naim (2009)	Add BTO and STS to MTS, ATO, MTO and ETO.
Build-to-stock (BTS)	Stavrulaki and Davis (2010)	Add BTS and DTO (see above) to ATO and MTO. They refer to BTS with respect to MTS.

Table 32: Different production situations identified in the literature

As can be seen from the above, there is a wide range of abbreviations describing different production situations. In their article, Amaro et al. (1999) argue that the various production situations are broad and imprecise divisions, and consequently, that there will be a considerable diversity of the companies included in each category. This is also pointed out by Porter et al. (1999, p. 192): “In reality most manufacturing organizations do not fall wholly within any one class.” As a response to this, researchers have developed more specific taxonomies for non-MTS

(Amaro et al., 1999) and ETO (Wacker and Miller, 2000; Hicks et al., 2001; Wikner and Rudberg, 2005). These taxonomies will be further described in the next paragraph.

Taxonomies for non-MTS companies

In their article, Amaro et al. (1999) find that the non-MTS environment can be divided into two sectors: The versatile manufacturing company sector and the repeat business customer sector. The first is involved in a competitive bidding situation for every order, whereas the latter may receive a series of similar orders. They further make a new taxonomy for the non-MTS production environment based on three dimensions: The degree of product customization, spanning from “pure” (new design), via “tailored” (modify existing design) and “standardized” (pick from set of design options) to “none” (use existing design as it is); the scope of the company’s responsibility for the design and specification of products; and, the activities performed after winning or accepting an order, i.e. assembly, processing, purchasing, routing, specification and design. After removing combinations that do not make sense, so to speak, they find 11 types of non-MTS companies, four of which are classified as ETO; according to the first dimension they are offering purely customized products, but differ with respect to the two other dimensions.

Wacker and Miller (2000) decompose ETO in two types; configure-to-order (CTO) and invent-to-order (ITO). According to them, CTO involves making a product very similar to products produced in the past, while ITO requires a substantial amount of engineering time spent in inventing and designing the product.

Hicks et al. (2001) develop a typology of four ideal types of ETO companies based on the variables of depth of product structure, which indicates product complexity, and volume of production, which determines whether jobbing, batch or flow (see e.g. Slack et al., 2010) processes are employed. The four ideal types (vertically integrated; design and assembly; design and contract; and, project management) all have a deep product structure; however, they differ with respect to core competencies, competitive advantage, vertical integration, supplier relationships, environment and type of risk.

As seen previously, it has been argued that the continuum of production situations is closely related to the CODP. Wikner and Rudberg (2005) claim that most scholars adopt a linear approach to the concept of CODP, and by adopting this approach they do not differ between production- and engineering-related activities. As such, the authors argue that the linear continuum does not realistically illustrate the actual situation many companies face. To deal with this, they propose a two-dimensional CODP (they refer to CODP as e.g. Wortmann (1992) refers to production situations) consisting of an engineering dimension and a production dimension. They argue that the engineering dimension can be separated from the production dimension because ETO can be seen as a special case of MTO, as the entire production flow is driven by customer orders. While the production dimension is the “traditional” MTS_{PD} , ATO_{PD} and MTO_{PD} , the engineering dimension ranges from ETO_{ED} , via adapt-to-order (ATO_{ED}) to engineer-to-stock (ETS_{ED}); highlighting that designs to a various degree may be produced prior to customer orders.

In conclusion, many firms can be characterized as engineer-to-order; ETO companies can range from being highly integrated with in-house manufacture, to pure design-and-contract organizations (McGovern et al., 1999). In an extreme form, an ETO setting consists of a multi-project situation where the form of the finished product only becomes apparent during the execution of the project (Wortmann, 1995). In the next section, identified general characteristics of ETO companies will be presented.

5.2 Characteristics of ETO companies

In general, the context around an ETO company is characterized by a high degree of uncertainty (Bertrand and Muntslag, 1993)¹³, with dynamic market characteristics and volatile demand (Muntslag, 1994). Uncertainty upstream towards suppliers is also experienced – often due to high lead times, detailed specifications and process duration (Konijnendijk, 1994). Further, McGovern et al. (1999) argue that the context around an ETO company can be of a very complex nature, due to deep product structures, a high mix of volumes of demand, and missing information and engineering revisions due to overlapping of production and design activities. McGovern et al. (1999) do, however, not specify what is meant by complexity; as such, we include the definition of complexity by Christopher (2011). He defines complexity as a condition of interconnectedness and interdependency across a network, and describes the most common sources of complexity in the supply chain. These are summarized in Table 33.

Type of complexity	Explanation
Network	The more links and nodes that constitute a network, the more complex it becomes.
Process	Processes, both internal and external, have often been developed in a random way, with extensions or modifications undertaken to reflect new requirements. As such, the process has become more complex.
Range	As the range, of products or services a company offers, increases so does its complexity.
Product	Complexity associated with products can emerge because the product consists of many components which has little commonality between them.
Customer	This source of complexity arises as a result of customized solutions to the customer. However, if these solutions deliver real value to the customer, for whom they are willing to pay, the complexity can be justified.
Supplier	As the number of relationships that must be managed, in addition to transaction costs, increases with the size of the supplier base, this causes the supply chain complexity to rise as well.

¹³Bertrand and Muntslag (1993) and Muntslag (1994) are cited frequently in this section of the thesis, both due to the article's relevance, and the lack of other studies on the topic of interest.

Type of complexity	Explanation
Organizational	Most companies are organized around functions and the organizational charts tend to have many levels in a hierarchy. This has a tendency to create functional “silos” in which each function has their own agenda. Thus the functions often become inward looking with a focus on efficiency, rather than, focusing on effectiveness and the customer. In order to prevent or reduce this type of complexity is to create more cross-functional collaboration.
Information	Information complexity is caused by the immense volume of data that flows between all entities and levels in the supply chain. This last type of complexity is influenced, more or less, by the aforementioned complexities.

Table 33: Common sources of complexity (adapted from Christopher, 2011)

Christopher (2011) emphasize that not all complexity is counterproductive; “In some respects it is through complexity that organizations differentiate themselves from their competitors” (p.168); thus, one must understand which value the customers appreciate and then provide this value with as little complexity as possible.

In reviewing the literature, we found it convenient to structure our findings in relation to ETO characteristics in five main categories: Products; processes; markets; uncertainty and risk; and, identified challenges. These are the topics of the following six subsections.

5.2.1 Products

From their research on ETO companies, Hicks et al. (2000) note that the products produced in ETO companies in general are complex with deep product structures and a high diversity of components. Some of the components are required only in low volumes, while others are needed in higher volumes; some components are standardized, while others are customized; some are technologically advanced, whereas others are not. In general, a high degree of customization often leads to long lead times, and makes outsourcing of subcomponents hard, as the complete product often is not fully specified until after the design and engineering process is done (Hicks et al., 2000). The products can be characterized as one-of-a-kind, which often leads to the need for purchasing materials which is specific to this one product (Bertrand and Muntslag, 1993). In addition, the products are in general highly priced (Stavrulaki and Davis, 2010).

Wortmann (1992) argues that a product strategy should be formed explicitly in this type of business. The strategy should specify which features and components of the product that can be negotiated about, and within which limits the customer can specify his product (Wortmann, 1992).

5.2.2 Processes

According to Caron and Fiore (1995), the processes of ETO manufacturing companies can be characterized as non-repetitive, or “pulse” processes, with the same discontinuity aspects as those found in engineering and contracting projects; temporariness, uniqueness and multi-

functionality. However, they argue that ETO manufacturing companies are different from engineering and contracting projects due to the fact that a considerable portion of the manufacturing and assembly processes are carried out at the corporate premises, using a production system managed according to suitable manufacturing policies. This is in contrast to engineering and contracting projects, where more 'ad hoc' production systems are followed (Caron and Fiore, 1995).

From a study of different ETO companies, Hicks et al. (2000) have generalized the business processes of an ETO company, and divide them into three stages; *marketing*, *tendering*, and *contract execution*. According to these authors, the first stage of an ETO company's complex process is marketing. Here, the decision on whether to tender or not is made, based on customer requirements, commercial factors, the company's ability to compete, and the likelihood of success. Second, a decomposed stage of the process is the response to an invitation to tender for a contract. At this stage, the company contacts potential suppliers, to get information on costs and lead times. There is a need for an understanding of the customer's needs in terms of technical features, price, delivery and quality. Further, Hicks et al. (2000) describe that in the last stage of the process, given that the company has won the contract, activities are development of a project plan and detailed design, procurement, component manufacturing, assembly, construction and commissioning.

The degree of vertical integration of the company decides how many of the activities the company does itself. In general, typical participants in these activities are engineers, designers, estimators, suppliers, fabricators, contractors, architects and owners (Pandit and Zhu, 2007). ETO companies often reduce the degree of vertical integration, as outsourcing is increasingly used (Hicks et al., 2000).

5.2.3 Markets

Bertrand and Muntslag (1993) claim that the market and manufacturing situation for ETO companies is characterized by high fluctuations in, for instance, sales volume and product mix – which ETO companies has to cope with both in the short and medium term. According to them, this is a general characteristic for ETO, and external flexibility is needed for coping with these fluctuations. They do, however, not explain what they mean by external flexibility; as such, we see it as beneficial to include a description of flexibility by Beckman and Rosenfield (2008). These authors state that one of the greatest benefits of being flexible is the ability to customize the company's products to their customers' needs. They further mention that there are several types of flexibility that a company can develop; however, the most common are *volume flexibility* and *product (or service) flexibility*; the former relates to the capability to respond to variability in demand quantity, while the latter is used to respond to changes in the mix of products (or services) the company offers. The authors proceed by explaining that the benefits incurred from increased flexibility must be traded off against the cost of achieving this flexibility. Further, attempts to achieve flexibility can easily get out of hand, resulting in a more disorderly environment.

In their literature review on engineer-to-order supply chain management, Gosling and Naim (2009) found that studies on ETO companies have been done in sectors such as construction, high technology /capital goods, automotive, shipbuilding, consumer electronics and general manufacturing. Most of the research within ETO focused on strategy for construction, and supply chain structures and strategy for production of capital goods. Research on the automotive, consumer electronics, general manufacturing and shipbuilding sectors, was mainly related to discussions around lean and agility. According to Gosling and Naim (2009), the commonality between the researched sectors is that ETO companies work within a project environment and that each product is different from the last.

5.2.4 Uncertainty and risk

Muntslag (1994) discusses uncertainty and risk for ETO companies. He refers to risk as “a situation in which various, mutually exclusive events may occur, each leading to a substantially different result in terms of quality, timeliness and cost” (Muntslag, 1994, p.100). He further makes a distinction between three types of order-dependent risk in ETO situations: *Technical or quality risk* –the situation where a product cannot be technically produced, leading to more product engineering and detailed design; *Time risk* – the situation where the throughput time in engineering and manufacturing is longer than what was estimated in the quotation phase; and *Financial risk* – the situation where the costs of engineering and production are higher than estimated in the quotation phase. This risk may arise from the aforementioned types of risk.

Further, in the study by Muntslag (1994), as well as in Bertrand and Muntslag (1993), three uncertainty factors are recognized: *Product specification uncertainty*, *process specification uncertainty* and *product mix and volume uncertainty*. These uncertainties might include one or more of the discussed risks (Muntslag, 1994). Product specification uncertainty arises as the final product specifications are not set in the quotation phase. As a consequence, this may lead to technical risk if the product concept turns out to be incomplete or incorrect. Additional engineering and/or design and production might be necessary, which can lead to both time and financial risk. It can be difficult to plan the use of resources and capacities in the quotation phase when the product specifications are not fully set – potentially causing process specification uncertainty. As a consequence, a company’s operational planning may become inaccurate compared to what is needed to produce the required components in time. Hence, this process uncertainty can lead to both time and financial risk if the resources needed to produce are not available when needed. As the demand (volume) and specifications (product mix) in products can be highly fluctuating, it can be hard to reserve production capacity. This uncertainty can lead to time risk if demand exceeds what is forecasted in a certain period. As penalty clauses may be present, financial risk might also occur.

5.2.5 Identified challenges

Problems that typically occur from highly customized production are difficulties in estimating lead time and delivery dates, expensive rework, poor product quality, conflicts between manufacturing and marketing schedules, and material waste (Pandit and Zhu, 2007). Of these, lead time is often regarded as the biggest challenge (Elfving et al. 2005; Pandit and Zhu, 2007). Long lead times in ETO companies can occur for several reasons, of which many relate to the

design: Slow collection and poor reliability of design input; changes due to early commitment and lack of knowledge; changes due to design errors; coupling ETO product design to other systems design; outdated practice of auxiliary design and approvals; and complexity – requiring large number of specialists (Pandit and Zhu, 2007).

Elfving et al. (2005) argue that too many design decisions are made too early due to long lead times, and are hence based on insufficient understanding. They state that this can lead to sub-optimal solutions, quality defects and rework. Consequently, they propose three strategies to mitigate lead times: (1) the various tasks in the project schedule can be overlapped with each other; (2) the various tasks can be decoupled and executed in a parallel manner; and (3) some tasks can be entirely eliminated or their task duration is reduced. Elfving et al. (2005) further argue that the first strategy of overlapping, for instance of concept development and implementation, may in addition reduce uncertainty and improve flexibility towards the market. According to them, cross-functional communication and coordination is a pre-requisite for this to happen. Further, if tasks are to be executed in parallel (second strategy), a removal of the coupling between tasks has to happen. This may require a rethinking of business processes, which can be difficult. In the field of construction, this is achieved by decoupling larger buildings into “building blocks” which are produced relatively independently in parallel (Elfving et al., 2005). The third strategy may significantly reduce lead times; but there is a danger that the overall lead time in fact may increase if the interdependencies between tasks not is taken into consideration; this also applies for cost. Due to this, lead time reduction initiatives should be viewed from a systems perspective (Elfving et al., 2005).

Little et al. (2000) note that common for ETO companies, is the feature of *change orders*. It is argued from these authors that the capability to respond to these short term dynamics is a prerequisite for success in many ETO companies. Krajewski et al. (2005) also recognize this, and argue that companies have three ways to cope with these short term dynamics: The use of supply contracts to get tighter control over a buyer’s demand changes; the use of suppliers’ capabilities in adaptive production scheduling; and the use of postponement. Krajewski et al. (2005) further argues that reaction strategies should be developed, which considers a capability of short term flexibility.

5.3 The need for cross-functional integration in ETO companies

Several researchers (Konijnendijk, 1994; Kingsman et al., 1993; Hicks et al., 2000) have uttered their opinions on the subject of cross-functional integration in ETO companies. Here, we present research made to promote integration of *manufacturing and marketing*, and *purchasing with design and marketing*, respectively.

5.3.1 Manufacturing and marketing

Konijnendijk (1994) argues that reciprocal interdependencies exist between manufacturing and marketing at the operational level, due to high uncertainty and the fact that a product is not certain until it is fully specified. He further argues that manufacturing and marketing should coordinate both the lead time quoted to the customer, together with any potential changes in the product specification or planning that may influence this lead time.

Further, Kingsman et al. (1993) argue that the manufacturing function often is faced with unrealistic delivery dates for incoming orders, which can be the case if the sales and marketing personnel set ambitious prices and delivery dates to win an order. They suggest that manufacturing and marketing should be integrated in order to minimize production planning problems. The reason for the lack of integration, Kingsman et al. (1993) argue, is that marketing and manufacturing have differing objectives: Sales/marketing wish to maximize their number of orders received, adapting quickly to shifting market demand. Cutting quotation prices and delivery times can thus be a temptation for the sales and marketing personnel. Manufacturing, however, prefer a stable and smooth workload over time, to cut product-, overhead- and inventory costs (Kingsman et al., 1993).

5.3.2 Purchasing, design and marketing

One way to reduce costs for an ETO company is to involve the purchasing function in design and tendering decisions (McGovern et al., 1999). Burt and Doyle (1993, referred to in Hicks et al., 2000) found that 75-80% of total avoidable cost is controllable at the design stage – implying that early involvement of the purchasing function in tendering and design is essential to reduce cost.

Further, Hicks et al. (2000) argue for a company to do proactive purchasing; the purchasing function has to be involved in the development of specifications, as the purchasers may contribute with knowledge of potential suppliers' capabilities and performance. According to Hicks et al. (2000), information sharing between functions is necessary: "Effective sharing of information requires use of common databases that support tendering, design, procurement, and project management. This requires records of previous designs, standard components and subsystems together with costing, planning, vendor performance and sourcing information" (Hicks et al., 2000, p. 189). These authors claim that this knowledge is a source to competitive advantage for ETO companies.

5.4 Purchasing in ETO companies

Research on purchasing has been dominated of studies on supply chains where a focal producer has high buyer power (Cox, 2004). In the ETO setting, however, the characteristics are different, and the same assumptions do not hold for buyer-supplier relationships (Hicks et al., 2000). Cox (2004) has the same reasoning, stating that what could be appropriate for a buyer in its relationship with its supplier in "one circumstance (of continuous, high volume, standardized demand) is unlikely to be appropriate in another (where there is infrequent, low volume and non-standard demand)" (p.348) (3.6.3). The latter may be recognized to reflect the ETO production situation (5.2.3; 5.2.4)

Hicks et al. (2000) argue that relationships with suppliers in ETO vary due to numerous factors: Differing levels of vertical integration; variations in volume for different types of components; the degree of customization of components; the level of concurrent engineering activity; the value of the item concerned; the proximity to the critical path; and the power balance within the particular buyer/supplier relationships (Hicks et al., 2000, p.186). The authors claim that this

diversity of factors implies that caution must be made when comparing literature on the high-volume sector with the low-volume sectors.

Hicks et al. (2000) find that an increasing part of an ETO contract is outsourced, and argue that the management of these suppliers is crucial; making the purchasing function of strategic importance. McGovern et al. (1999) argue that the interface between internal processes and capabilities of ETO companies and suppliers is crucial. However, Hicks et al. (2000) find that ETO companies often have reactive purchasing functions, rather than proactive; the purchasing function also tends to be departmentalized and clerical in nature – often using a lowest price purchasing strategy. Further, they find that it is common to use adversarial trading approaches with multiple suppliers at a time – characterized by win-lose transactions and mistrust.

According to McGovern et al. (1999), ETO companies are becoming more and more dependent on their suppliers in handling the increased time pressure posed by demanding customers. In addition to this, an ETO company should have the short term flexibility to quickly access and use the knowledge of their suppliers in the quotation phase (McGovern et al., 1999). However, these authors also argue that demand uncertainty constrains the possibilities for cooperative long-term relationships within the ETO supply chain. It is argued that demand characteristics and power characteristics in relationships are key variables which determine the appropriateness of such approaches (Gosling and Naim, 2009).

McGovern et al. (1999) mapped the procurement decisions in ETO companies, and found that they can happen in three ways: The customer specifies preferred suppliers; the sourcing of components and subsystems are specified at the tendering stage; and design and/or engineering can specify sourcing instructions during their work. In general, purchasing gets the final specifications, which are either of a functional (giving the suppliers responsibility to design) or detailed technical form (limiting the supplier's freedom to design of components), from the design function (Hicks et al., 2001). According to Hicks et al. (2001), this is an important handover. They further argue that the latter form of procurement decision by McGovern et al. (1999) may constrain innovation and create unnecessary in-house design and procurement activity. The importance of specifications is also recognized by McGovern et al. (1999), who state that “ETO companies derive competitive advantage through understanding customer requirements, translating them into specifications at product and component level, and integrating components and subsystems into products” (p.150). In the next section, we conclude this chapter by stating what will be brought along to the theoretical framework.

5.5 Towards the theoretical framework – Engineer-to-order

The main purpose of this chapter has been to provide a necessary understanding the engineer-to-order production situation. Several central topics related to the concept have been presented. We will now gather and classify findings that will be brought along to the construction of a theoretical framework at the end of this part. These findings will, as for purchasing portfolio approaches (chapter 3) and purchasing sophistication (chapter 4), subsequently be used; both for answering RQ1 and structuring and guiding the analysis. In the analysis (chapter 8), these findings will be refined using empirical data gathered through our mixed methods research, c.f. 2.1.3.

We found that literature on the ETO production situation allegedly is sparse compared to that of the high-volume production situation. Many authors have tried to classify production situations like ETO with different taxonomies and terminologies, often using the concept of CODP as the point of departure (5.1.1). It is concluded that no consensus have been made in the literature regarding terminology, but there is an implicit agreement in the literature that, for an ETO company, the CODP lies at the design stage in a project. We argue that even though some components may be standardized, at least parts of the product are engineered-to-order; resulting in this position. This engineering component (one or several) distinguishes ETO from other production situations. This will be brought along to the theoretical framework.

In order to understand the ETO production situation thoroughly, a review of ETO characteristics was done. We found that these characteristics could be organized in terms of products, processes, markets, risk and uncertainty and challenges (5.2). We feel that these topics are essential; hence, we include them in the theoretical framework. In addition, a need for cross-functional integration in ETO companies was identified (5.3). Thereafter, theory on purchasing in ETO companies was presented (5.4). These are appropriate topics to include for subsequent analysis. In summary, the findings to be brought along to the development of a theoretical framework are illustrated in Figure 30 below.

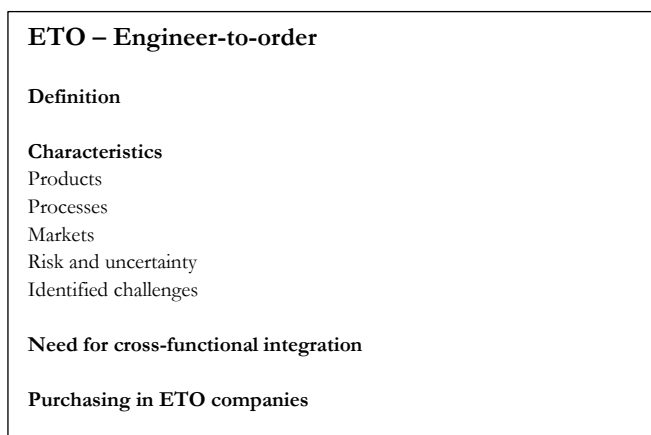


Figure 30: Findings from ETO brought along to the theoretical framework

Conclusion Part I

We now present, in part, a conclusion to the first research question, “what are important features of purchasing portfolio approaches, purchasing sophistication and engineer-to-order?”, by constructing the theoretical framework. As mentioned in 2.1.3, this framework will further be refined, using empirical findings, in the first chapter of the analysis (chapter 8). The refined framework concludes RQ1. The body of theory presented is rather comprehensive, constituting three chapters on the topics of purchasing portfolio approaches, purchasing sophistication and engineer-to-order. Organizing relevant findings into a theoretical framework is tidily, and it helps structuring subsequent parts. Our theoretical framework is presented in Figure 31 below.

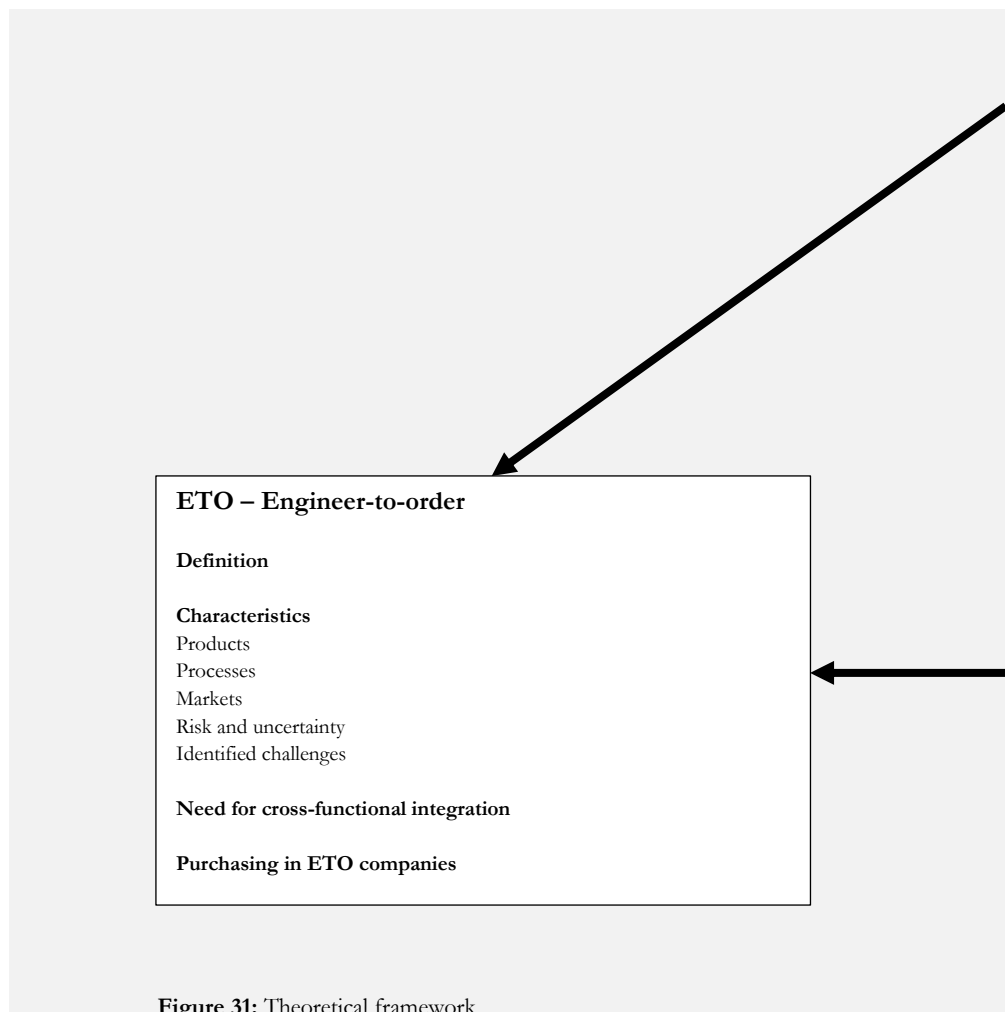
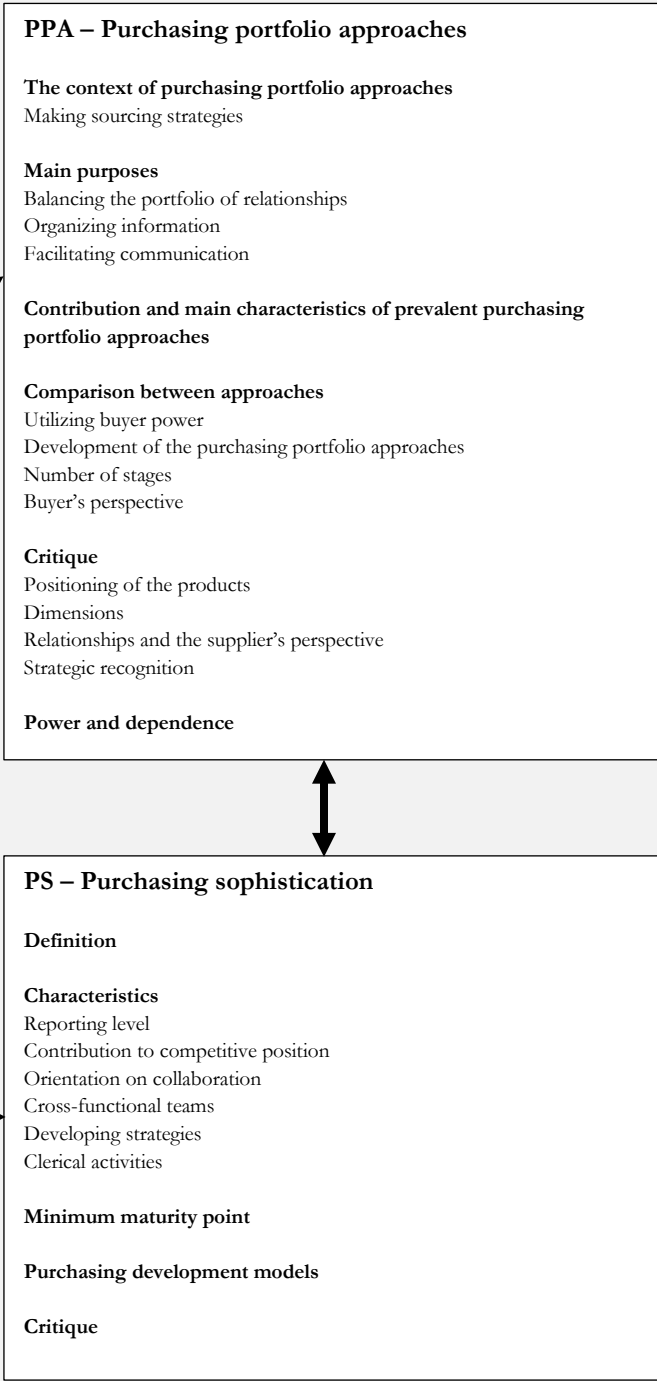


Figure 31: Theoretical framework



Part II: Empirical investigation

In this part we present our empirical foundation, comprising survey- and action research findings. In chapter 6, the survey findings are presented. The findings are organized according to the main topics of the theoretical framework developed in Part I (Figure 31). In chapter 8, we present our findings from the action research. The chapter is organized according to our action research protocol (A.2); however, explicit observations are labeled according to the topics of the theoretical framework. These observations are summarized in appendix A.5 for the reader's convenience.

This part provides the basis for the analysis, where the master's thesis' research questions and the overall problem formulation (1.2) are answered.

6 Survey research findings

This chapter presents findings from our survey research. First, a motivation of the variables used in the survey research is given, before a presentation of our sample is provided, elucidating different characteristics of our respondents. This is followed by three succeeding sections, which provide findings from our survey research in relation to the topics constituting the ternary relationship between purchasing portfolio approaches, ETO companies and purchasing sophistication (1.2). Finally a section summarizes our major findings.

6.1 Relevant variables used in the survey analysis

In our analysis of the survey data, we have utilized several variables in order to derive findings in relation to the ternary relationship comprising ETO, purchasing portfolio approaches and purchasing sophistication. In addition to the variables directly concerning the ternary relationship, we have used the following variables: *having a purchasing department*, *possessing a sourcing strategy*, *company size* and *purchasing-to-turnover ratio*. The motivation for including these variables in the questionnaire and, hence, the analysis (Part III), is described in this subsection.

6.1.1 Having a purchasing department

In order to get an indication of the priority of purchasing within a company, we included the dichotomous variable of whether a company has a separate purchasing department or not. Quayle (2002) employed a similar question in his exploratory survey research of 400 small and medium size enterprises (SMEs), discovering that few companies (about 20%) had their own purchasing department. However, the author discovered that 81% had a designated employee, who, among other duties, was responsible for purchasing.

6.1.2 Having a sourcing strategy

As the use of purchasing portfolio approaches is employed in the context of creating a sourcing strategy (3.1.1), a nominal variable was included to specify whether or not a company has a sourcing strategy. This was done in order to establish the theoretical link between using a purchasing portfolio approach and having a sourcing strategy, with empirical data. In addition, we suspect that this variable may be related to the level of sophistication, as it requires skills for developing strategies by the purchasers, and as it has a negative relationship towards clerical duties, which both are indicators of higher purchasing sophistication (4.4).

6.1.3 Company size

It is identified in theory that smaller firms have fewer resources than larger firms (Boyer et al., 1996). In addition, a larger company is, according to Carr and Pearson (1999), believed to have more flexibility to “devote resources to strategic purchasing activities” (p.512). Further, Quayle (2002) discovers that small and medium-sized companies lack an awareness of effective purchasing; positively affecting profitability. Gelderman and van Weele (2005) support this view in stating that larger companies are more likely to handle more products, more suppliers and a more complex sourcing situation; consequently, there is a need for “more advanced analytical

tools to develop supplier strategies” (p.24). Hence, company size was considered to be an important variable to include in our questionnaire.

In accordance with the Norwegian convention for determining the size of a company (Regjeringen, 2012), we used the number of employees to determine a company’s size. The number of employees was also used by Quayle (2002) to measure company size. Carr and Pearson (1999) used gross sales dollars as a measurement of company size; however, this was not compatible with the convention for company size employed in this research, and thus rejected.

6.1.4 Purchasing-to-turnover ratio

As an indicator of the importance of purchasing for a company, we measured what we define as the *purchasing-to-turnover ratio*. This measure is adopted from van Weele (2010), who argues that purchasing decisions will have a more profound impact on net results when this ratio increases (1.1.4)¹⁴. This ratio is calculated as a company’s cost of goods sold (COGS) divided by its annual turnover. A similar measure was employed by Quayle (2002). However, he did not derive any substantial findings by using this variable. Our intention for including this ratio/interval variable was to evaluate its effect on the other relevant variables in this research. Next, a presentation of the sample used in the survey research is given.

6.2 Sample

In the following section, a presentation of the sample used is provided in order to enhance the understanding of the external validity of the results derived from the analysis (2.4.1). The topics presented are: response rates, production situations, company position of respondents, industry distribution, company size, purchasing-to-turnover ratio, and testing for nonresponse bias. At the end of this section, an evaluation of the sample is given.

6.2.1 Response rates

A total of 144 useful answers from respondents were received from five different samples. These respondents are distributed among the samples as shown in Table 34.

DISTRIBUTION OF RESPONDENTS				
Sample	Sample size	Respondents	Percent of total sample	Response Rate
NIMA	N/A	25	17,4	N/A
NCEI	20	11	7,6	55 %
NCE Subsea	98	42	29,2	43%
NCE Maritime	96	45	31,3	47%
NCE Node	52	21	14,6	40%
Total	N/A	144	100	

Table 34: Distribution of respondents

¹⁴ Van Weele (2010) refers to the ‘purchasing to sales ratio’; we have merely relabeled the measure.

As shown in Table 34, the response rates varied from 40% to 55% in the different samples. This rate is notably higher than the average response rate of 32%, identified in theory (2.4.3). This indicates that the survey instrument was indeed carefully constructed, and that we should not be concerned with the notion of non-response bias undermining our findings from the analysis. In addition, we argue that because of our high response rate, we have received answers from a variety of respondents; not only those who are the most eager and prosperous. In this respect have a more representative sample of our population. For our NIMA sample, we were not able to calculate a response rate, as we have insufficient knowledge of how many companies it was distributed to¹⁵.

Further, respondents who have ignored some questions of the questionnaire are kept as long as the answers provided are sufficient to conduct tests with two variables. Consequently the number of respondents used in the following tests will vary depending on which variables are tested. Thus, the sample size will be explicitly stated for each variable.

6.2.2 Production situation

We see it fit to provide a distribution of the respondents according to their production situation, in order to separate answers from ETO companies from others. This is provided in Table 35 below.

DISTRIBUTION OF RESPONDENTS ACCORDING TO PRODUCTION SITUATION					
	Production situation*				
Production situation	MTS	ATO	MTO	ETO	Non-production
Number of respondents	10	11	24	42	55
Percentage of total sample	7,0%	7,7%	16,9 %	29,6%	38,7%
*N = 142 (2 missing)					

Table 35: Distribution of respondents according to production situation

As seen from the table above, it is evident that ETO companies constitute the bulk of the responding production companies; only the group of non-production respondents is larger. Consequently, we argue that ETO is well represented in the sample, establishing a solid foundation for subsequent comparisons between ETO and non-ETO companies.

6.2.3 Company position of respondents

In order to ensure that the respondents possessed adequate knowledge of their purchasing operation to answer on behalf of the company, we investigated the company position of our respondents (2.4.3). The findings are presented below (Table 36).

¹⁵ An e-mail exchange with NIMA revealed that they did not have information of the number of companies registered. Even though we know the association has about 2200 members, several of these are students and there are multiple members within a single company, reducing the number of adequate respondents considerably.

COMPANY POSITION OF RESPONDENTS		
Job Title	Frequency	Percentage of total sample
Director Purchasing	7	4,9
Purchasing Manager	44	30,6
Senior Buyer	10	6,9
Purchasing Assistant	1	0,7
Purchaser	7	4,9
Supply Chain Manager	5	3,5
Director Logistics	1	0,7
Logistics Manager	3	2,1
Production Manager	2	1,4
Consultant	3	2,1
General Manager	28	13,9
Chief Executive	13	19,4
Other	20	9
Total	144	100

Table 36: The company position of respondents

From Table 36, it is apparent that the respondents are primarily purchasing managers, senior buyers, general managers or chief executives. Consequently, we argue that the respondents can be considered to have sufficient knowledge of their company's purchasing operations – enhancing the credibility of our received answers.

6.2.4 Industry distribution

Figure 32 illustrates how the respondents are distributed among different industries. The different NCE samples (Instrumentation; Subsea; Maritime; Node) are treated as one sample with respect to industry, due to similarities in their areas of operations.

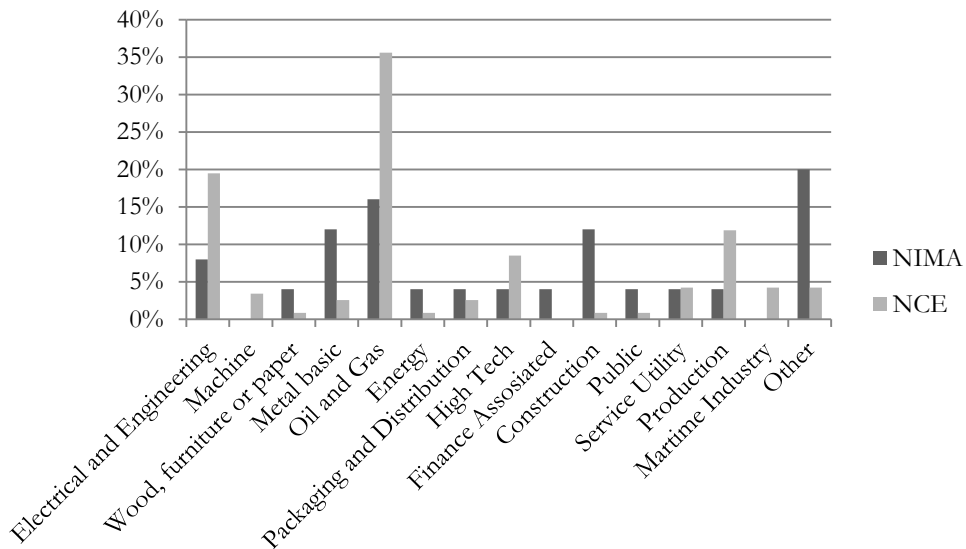


Figure 32: Distribution of companies over different industries

Comparing the NIMA and NCE samples, it is evident that the NIMA sample has a more even distribution among different industries. The NCE sample consists mainly of companies operating within the oil and gas industry; this is not surprising considering the population it represents (2.4.3). However, we have not been able to determine whether this distribution is representative for Norwegian production companies¹⁶.

A sampling frame (2.4.3) would reveal to which extent the respondents' distribution over different industries is representative for Norwegian production companies. In addition, a sampling frame would enable us to conduct random sampling (2.4.3); thus enhancing the external validity of the survey findings. However, mapping the sampling frame of all production companies in Norway would be impossible due to time and resource limitations on the authors' behalf (2.4.3).

6.2.5 Company size

Figure 33 displays the distribution of respondents according to company size. Here, we have used the Norwegian convention (Regjeringen, 2012) stating that a small company has fewer than 20 employees, medium-sized company has fewer than 100 employees (and more than 20) and larger companies consist of over 100 employees.

When combining small and medium-sized companies to form "Small- or medium-sized enterprises" (SME), it comprises 67.4% of the sample (97 respondents) (Figure 33).

¹⁶ We have sought to establish a sampling frame of Norwegian production companies; however, we could not agree on a proper classification scheme, as Statistics Norway, the Federation of Norwegian Industries and a similar study done by Gelderman and van Weele (2005) all utilize different classification schemes.

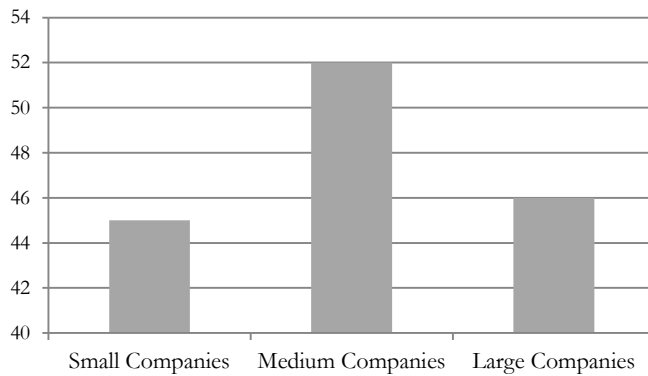


Figure 33: Distribution of respondents according to company size

Further, as ETO companies are a focus in this master’s thesis, we have investigated the distribution of ETO and non-ETO companies according to company size. The results are depicted in Figure 34.

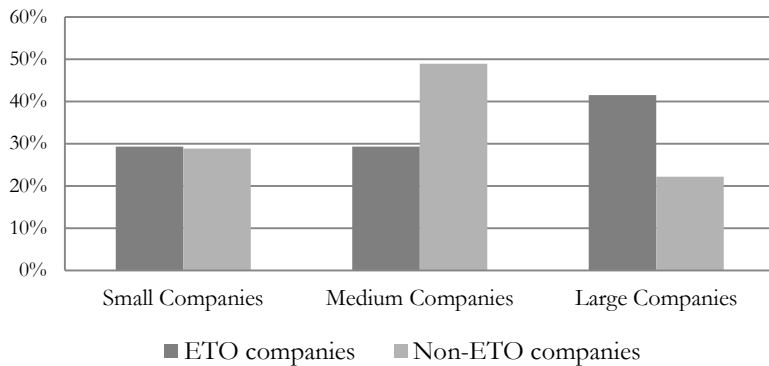


Figure 34: Company size distribution for ETO and non-ETO companies

When comparing the two samples, large companies are, in percentages, the most represented among ETO companies; whereas medium-sized companies are the most represented, in percentages, with respect to non-ETO.

6.2.6 Testing for nonresponse bias

As we had non-respondents in our survey research, we wanted to evaluate how the whole sample would have responded, as a significant difference between respondents and non-respondents would lower the quality of the survey research (2.4.3). Consequently, we tested for nonresponse bias. We only had the opportunity to send reminders to, and consequently separate between early and late respondents, in the NCE samples (2.4.3). As such, we were limited to test for nonresponse bias only in these samples. When comparing relevant variables between early and late respondents, no statistical significant differences were found. Hence, in line with

Armstrong and Overton (1997; 2.4.3), we conclude that the NCE samples are not subject to nonresponse bias.

6.2.7 Evaluation

A total of 144 useable respondents were collected from five different samples, and the high response rates support the conclusion from the previous subsection; the NCE samples are not subject to nonresponse bias. Furthermore, ETO companies constitute the largest group of production companies in the total sample. As such, we have a solid foundation on which we can compare ETO to non-ETO companies. In addition, the distribution among company positions of our respondents makes us conclude that we have received an accurate description of the companies purchasing operations. In relation to company size, we see a majority of medium-sized companies in our total sample. Small and medium companies together constitute about two thirds of our total sample. Finally, when testing for nonresponse, we found no significant difference between late and early respondents in the NCE samples.

In summary, we argue that we have obtained a sample suitable for subsequent analysis, without any major identified sources of bias.

6.3 The use of purchasing portfolio analysis

In this section, findings related to the use of purchasing portfolio analysis are presented. Hence, these findings are directly related to the corresponding topic of the ternary relationship (Figure 9). First, we present how many of the respondents that utilize purchasing portfolio approaches, and non-users' stated reasons for not doing so. In the subsequent sections, we analyze the following in connection to the use of purchasing portfolio approaches: having a purchasing department, possessing a sourcing strategy, company size, and the purchasing-to-turnover ratio. A conclusion at the end of this section summarizes the findings.

6.3.1 Using a purchasing portfolio approach

In our overall sample, 47.1 % of the respondents stated that they, with various frequencies, use purchasing portfolio analysis. The remaining 52.9 % percent of the sample provided the reasons displayed in Figure 35 for not using such analysis.

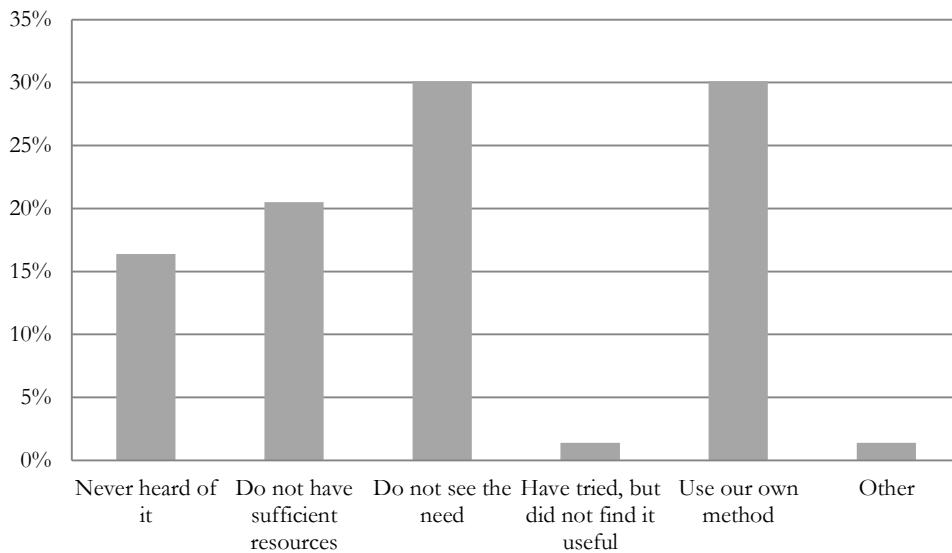


Figure 35: Reasons for not using a purchasing portfolio approach

From Figure 35 it is apparent that the most prominent reasons for not using purchasing portfolio analysis are that the company has its own method or do not see the need for such a tool. The “other” reasons for not using purchasing portfolio analysis were: “we only purchase as required in projects, though some to temporary stock using automatic re-ordering”; “we work with standardization and series production, however much is at a prototype level. We are (literally) a company in development, and have a way to go for standardization of the ‘heaviest’ product costs”; “the questions are irrelevant for a company that only sells services”; and “we are small, and purchasing is very limited... it is mainly office supplies etc.” Next, we investigate to which extent having a purchasing department affects the use of purchasing portfolio approaches.

6.3.2 Having a purchasing department

A slight majority of the respondents (52.4 %) do not have a purchasing department. In those companies that *do have* an established purchasing department; the size fluctuates between one to fifty employees. The median¹⁷ of the purchasing department’s size is 4.

Further, an examination of the relationship between the usage of purchasing portfolio analysis (dependent variable) and whether or not a company has a dedicated purchasing department (independent variable) was conducted. The result of the analysis is provided in Table 37, in addition with its associated chi-square test.

¹⁷ Bryman and Cramer (2011) state that when outlying values may distort the mean, the median should be considered; it will engender a more representative indication of the central tendency of a group of variables.

RELATIONSHIP BETWEEN PORTFOLIO ANALYSIS USAGE AND PURCHASING DEPARTMENT			
		Purchasing Department	
		Yes	No
Portfolio analysis usage ¹⁸	Have used	61,2%	34,2%
	Never used	38,8%	65,8%
	Total	N = 67	N = 73
* $\chi^2 = 9,128$ SS, $p < 0.01$, $\phi = 0,270$		*Yates' correction has been used in the computation of the chi-square statistic	

Table 37: Relationship between portfolio analysis usage and purchasing department

From Table 37, it is apparent that the null hypothesis (of no relationship between use of portfolio analysis and a dedicated purchasing department) is rejected with the computed chi-square value significant at a 0.01 level. Thus, there is a 1.0% chance that there is no relationship between these two variables in the population. Consequently, there is a significant relationship between these two variables.

6.3.3 Having a sourcing strategy

When analyzing the relationship between the usage of purchasing portfolio analysis (dependent variable) and whether or not a company has a sourcing strategy (independent variable), we discovered a significant relationship. This indicates that companies with a sourcing strategy are more likely to have used purchasing portfolio analysis and vice versa. The results of the analysis are displayed in Table 38.

RELATIONSHIP BETWEEN PORTFOLIO ANALYSIS USAGE AND SOURCING STRATEGY			
		Sourcing strategy	
		Yes	No
Portfolio analysis usage	Have used	56,9 %	21,1%
	Never used	43,1%	78,9 %
	Total	N = 102	N = 38
* $\chi^2 = 12,847$ SS, $p < 0.001$, $\phi = 0,319$		*Yates' correction has been used in the computation of the chi-square statistic	

Table 38: Relationship between portfolio analysis usage and sourcing strategy

¹⁸ Here, the use of portfolio model is re-coded as a dichotomous variable, in line with what was done by Gelderman and van Weele (2005).

6.3.4 Company size

An investigation of whether the use of purchasing portfolio approaches (dependent variable) is affected by the company's size (independent variable) was conducted. Here, we discovered a significant relationship between these two variables, indicating that larger companies are more likely to use a purchasing portfolio approach compared to smaller companies (Table 39).

RELATIONSHIP BETWEEN PORTFOLIO ANALYSIS USAGE AND COMPANY SIZE				
		Company size		
		Small companies	Medium-sized companies	Large companies
Portfolio analysis usage	Have used	26,7%	50,0%	63,6%
	Never used	73,3 %	50,0%	36,4%
	Total	N = 45	N = 50	N = 44
* $\chi^2 = 12,922$ SS, $p < 0.005$, $\phi = 0,300$				Total N = 139

Table 39: Relationship between portfolio analysis and company size

As there has been established a relationship between the use of purchasing portfolio approaches and both having a sourcing strategy and a purchasing department, we proceeded by analyzing if company size had an effect on the two latter variables. The results from our analysis revealed a significant relationship between company size and having a purchasing department, in which larger companies more often had a purchasing department compared to smaller companies (Table 39).

RELATIONSHIP BETWEEN HAVING A PURCHASING DEPARTMENT AND COMPANY SIZE				
		Company size		
		Small companies	Medium-sized companies	Large companies
Have purchasing department	Yes	11,1%	50,0%	82,2%
	No	88,9%	50,0%	17,8%
	Total	N = 45	N = 52	N = 45
* $\chi^2 = 45,739$ SS, $p < 0.001$, $\phi = 0,568$				Total N = 142

Table 40: Company size in relation to having a purchasing department and possession of a sourcing strategy

The percentage of SME companies with a dedicated purchasing department was 32.0%¹⁹, compared to 82.2% for larger companies. Further, the relationship between company size and having a sourcing strategy was also significant; the results are displayed in Table 41.

RELATIONSHIP BETWEEN HAVING A SOURCING STRATEGY AND COMPANY SIZE				
		Company size		
		Small companies	Medium-sized companies	Large companies
Sourcing strategy	Yes	55,6%	76,5%	86,7%
	No	44,4 %	23,5%	13,3%
	Total	N = 45	N = 51	N = 45
* $\chi^2 = 11,537$ SS, $p < 0.005$, $\phi = 0,286$				Total N = 141

Table 41: Relationship between having a sourcing strategy and company size

6.3.5 The purchasing-to-turnover ratio

The respondents from the total sample had an average purchasing-to-turnover ratio of 38.55%. For ETO companies, the average value of this variable is 38.38 % – indicating no considerable difference from the total sample average. In order to investigate whether there is a significant relationship between the purchasing-turnover-ratio and the use of purchasing portfolio analysis, we needed to recode the former variable into an ordinal variable. This was done through binning the variable into 10 % quantiles. The resulting ordinal variable (with frequency of each quantile) is displayed in the Table 42.

BINNING OF THE PURCHASING TURNOVER RATIO VARIABLE										
Interval (%)	0–10	10–20	20–30	30–40	40–50	50–60	60–70	70–80	80–90	90–100
Frequency	13	13	20	19	21	15	13	4	3	0

Table 42: Binning of the purchasing turnover ratio variable

The ensuing analysis revealed, however, no significant relationship between using portfolio analysis (dependent variable) and the purchasing-to-turnover ratio of the company (independent variable). Further, when investigating if there was a relation between the purchasing-to-turnover (independent variable) and if the company has a purchasing department (dependent variable), no significant relationship was detected. Company size was also tested against purchasing-to-turnover ratio; these results also revealed an insignificant relationship. On the other hand, there was a significant relationship between having a sourcing strategy (dependent variable) and the purchasing-turnover-ratio (independent variable), indicating that companies with a large

¹⁹ $\frac{(11.1\% \cdot 45 + 50\% \cdot 52)}{(45 + 52)} \approx 32\%$

purchasing-turnover-ratio is more likely to have implemented a sourcing strategy ($\chi^2 = 18,727$ SS, $p < 0.05$, $\phi = 0,390$).

6.3.6 Conclusion

In this section, we have investigated several variables, with respect to their relationship with the use of purchasing portfolio approaches. Our findings are summarized in Figure 36 (a solid arrow indicates a significant relationship, whereas a dashed arrow illustrates a non-significant relationship).

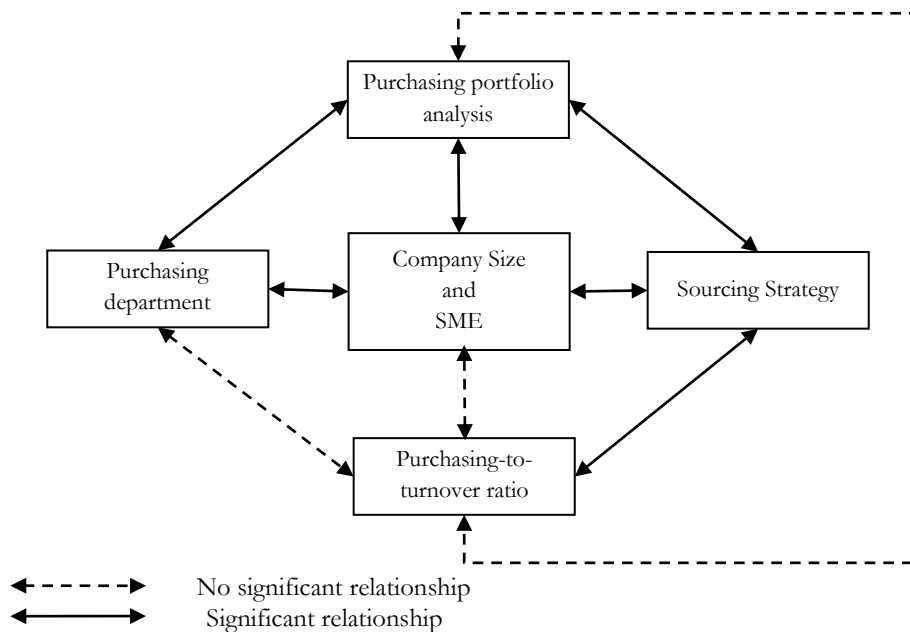


Figure 36: Relationship between using purchasing portfolio analysis and other variables

6.4 The purchasing function's level of sophistication

In this section, we present our findings in relation to purchasing sophistication. First, we provide an investigation of which variables that have a statistical significant effect on the level of purchasing sophistication. We then proceed by conducting an exploratory factor analysis, and investigate how these factors relate to important survey variables. Finally, a conclusion is provided with our major findings.

Preparing the data for analysis

Before embarking on the investigation of which variables that have an impact on the sophistication of the purchasing function, we needed to test the criterion variable (purchasing sophistication) for normality, in order to establish if we can utilize a parametric test such as the t-test (2.4.4). After calculating the significance value of the Shapiro-Wilk Test, which was 0.124,

and investigated the Normal Q-Q plot for this variable, we could establish that this variable forms a normal distribution. Further, as purchasing sophistication is measured by several indicators, we saw it necessary to evaluate its internal reliability (2.4.2). Cronbach's alpha for the purchasing sophistication variable is only 0.503. This measure should, however, be 0.70 or above (2.4.2). Nevertheless, we find that purchasing sophistication comprises several underlying factors (further elaborated in 6.4.3). In this relation, Bryman and Cramer (2011) state that it is normal to rather evaluate the internal reliability of each factor, than for the measure as whole. Consequently, we will calculate the internal reliability of each factor, and as such rely on these measures in order to evaluate the overall internal reliability of the measure of purchasing sophistication.

Furthermore, in order to eliminate response bias in terms of response sets (2.4.2), these (a total of 9 respondents) were removed from the sample. In addition, there were 7 respondents who did not provide sufficient answers on the variable of purchasing sophistication. Consequently, the sample used for the bivariate analysis with the variable of purchasing sophistication was reduced to 128 respondents.

6.4.1 Variables affecting purchasing sophistication

This subsection provides the results of the analysis of purchasing sophistication in relation to the previous investigated variables. In the succeeding paragraph, we investigate the impact on purchasing sophistication of having a purchasing department, sourcing strategy and using a purchasing portfolio analysis. We then proceed by analyzing to which extent purchasing sophistication is influenced by company size and the purchasing-to-turnover ratio.

Through conducting a t-test with the unrelated samples of companies in possession of a purchasing department and those without, and their mean level of sophistication, we found no statistical significance between the groups ($t = 1.123$, NS, $p > 0.26$), despite that the former group had a somewhat higher mean sophistication. When conducting the same test for companies with or without a sourcing strategy, and their mean level of sophistication, we discovered that companies with a sourcing strategy have a significantly higher sophistication ($t = 2.766$, SS, $p < 0.01$). Further, as expected, companies who used a purchasing portfolio analysis had a more sophisticated purchasing function. However, the difference from the mean of those companies who did not use such an analysis, was not significant ($t = -1,527$, NS, $p > 0,129$); thus we cannot conclude that there is a difference in sophistication between users and non-users of purchasing portfolio analysis in the sample.

As we could not establish a significant difference in sophistication between companies who used purchasing portfolio approaches from those who did not, we proceeded by analyzing the relationship between these two variables. In order to enable such an investigation, the level of purchasing sophistication was re-coded into an ordinal variable consisting of five groups, whose interval and frequency is displayed in the Table 43.

BINNING OF THE VARIABLE PURCHASING SOPHISTICATION			
Group	Interval	Frequency	Percentage
Very low	5 – 10	0	0,0%
Low	10 – 15	3	2,3%
Neutral	15 – 20	41	32,0%
High	20 – 25	68	53,1%
Very high	25 – 30	16	12,5%

Table 43: Binning of the variable purchasing sophistication

The results from the analysis of this relationship revealed that a higher percentage of companies with a very high purchasing sophistication used purchasing portfolio approaches. However, there were no significant relationship between using purchasing portfolio analysis and level of purchasing sophistication..

Company size

The relationship between company size (independent variable) and purchasing sophistication (dependent variable), is proven through analysis to be non-significant ($F = 0,113$, NS, $p > 0,89$). Further, the eta squared value suggest that only 0.2 % of the variance of purchasing sophistication can be attributed to company size. This may explain why the average sophistication between small, medium-sized and large companies nearly coincides (small companies: 21.7; medium-sized companies: 21.9; large companies: 21.5).

Comparing SME companies with larger companies in terms of purchasing sophistication, the former group of companies has a marginally higher average sophistication. Through conducting a t-test of these two types of companies, no significant difference in relation to mean purchasing sophistication was found ($t^{20} = 0.371$, NS, $p > 0.712$). Consequently, one cannot put too much emphasis on these results.

Purchasing-to-turnover ratio

In a similar manner as we investigated if there was a relationship between the purchasing-to-turnover ratio and the use of purchasing portfolio analysis, we wanted to investigate this former variable and its effect on purchasing sophistication. We conducted a correlation analysis of the purchasing sophistication and the purchasing-to-turnover ratio. However, the results displayed a virtual non-existent relationship between these two variables (Pearson's $r = -0.005$, NS, $p > 0.95$, $N = 128$).

Intermediate conclusion

As is evident from the preceding discussion, only companies with a sourcing strategy have a significantly higher purchasing sophistication compared to companies who do not have such a

²⁰ Levene's test was found to be significant; thus, separate variance estimates was used to calculate the t value.

strategy. The other investigated variables displayed no significant impact on, or relationship with, the level of sophistication of the purchasing function.

6.4.2 Comparing users of purchasing portfolio approaches

When investigating the difference between companies who employ a purchasing portfolio analysis from those who do not, in relation to their average score on each of the indicators of purchasing sophistication, Table 44 was generated.

MEANS OF THE PURCHASING SOPHISTICATION INDICATORS			
	Overall Sample Means	Users' Mean Score	Non-users' Mean Score
Reporting to Top Management	3,96	3,95	3,97
Contribution to Competitive Position	4,02	4,11	3,94
Orientation on Clerical Duties (recoded)	2,89	2,89	2,89
Orientation on Collaboration	3,77	3,81	3,72
Skills for Cross-Functional Teams*	3,59	3,75	3,43
Skills for developing Strategies**	3,48	3,60	3,35
Sample Size (N=)	128	63	65

*Statistical significant at $p < 0.05$; ** Statistical significant at $p < 0.10$ ²¹

Table 44: Means of the purchasing sophistication indicators

Table 44 points to the fact that only two of the indicators exhibit a significant difference in arithmetic mean between users and non-users of purchasing portfolio analysis: Skills for cross-functional teams and skills for developing strategies. The first indicator shows that non-users of purchasing portfolio analysis more often reports to top management. However, the means are not significantly different; thus, it is not probable that this result can be reproduced with a new sample from the population. The remaining indicators point to a higher mean score when using portfolio analysis compared to companies who do not; however, the differences are not significant.

6.4.3 Exploratory factor analysis

An exploratory factor analysis was conducted in order to reduce the number of indicators measuring the concept of purchasing sophistication (2.4.4). The resulting orthogonally rotated item loading is provided in Table 45 below.

²¹ Mann-Whitney U tests were employed to test for statistical significance between means of purchasing portfolio users and non-users.

RESULTS OF EXPLORATORY FACTOR ANALYSIS (ITEM LOADINGS)			
	Factor 1	Factor 2	Factor 3
Reporting to top management	0,863	-0,072	-0,192
Contribution to competitive position	0,797	0,257	0,019
Orientation on clerical duties (recoded)	-0,198	-0,034	0,841
Orientation on collaboration	0,501	-0,053	0,517
Skills for cross-functional teams	-0,003	0,827	-0,174
Skills for developing strategies	0,112	0,834	0,099
Sample Size(N=)	128		

Table 45: Results of exploratory factor analysis (Item loadings)

A principal-components analysis with varimax rotation was used. Further, by using the Kaiser's criterion in accordance with the Scree test of the eigenvalues, three factors were selected. Consequently, purchasing sophistication is a three dimensional concept according to our findings. The *first factor* consists of two indicators: (1) reporting to top management and (2) contribution to competitive position. This first factor coincides with the first factor discovered by Gelderman and van Weele (2005), who conducted the same factor analysis in a similar study. The authors defined this factor as 'purchasing position', which referred to "the internal position and status of the purchasing function in companies" (Gelderman and van Weele, 2005, p.24). As such, we see it advantageous to adopt the same definition.

The *second factor* is related to the skills of the purchasing professionals, consisting of the following two indicators: (1) skills for developing strategies, and (2) skills for cross-functional teams. This factor deviates from the second factor discovered by Gelderman and van Weele (2005), as it only comprises two indicators compared to the three indicators found by the authors (they include orientation on clerical duties as a third indicator). As such, we cannot adopt their definition of this factor and instead define our second factor as *skills of purchasing professionals*.

The *third factor* consists of only one indicator; orientation on clerical duties. Consequently, this factor indicates the extent the purchasing function is engaged in clerical duties, and is termed *nature of purchasing activities*. The last indicator cross-factor loaded²² on the first and third factor, and was not included in any of these two factors.

As the first two factors consisted of multiple indicators, a test for internal reliability was conducted through calculating the Cronbach's alpha (2.4.2). The calculations revealed a Cronbach's alpha of 0.713 and 0.580 for the first and second factor, respectively. As this measure should be above 0.70 to provide a satisfactory internal reliability (Bryman and Cramer,

²² i.e the indicator loaded above 0.3 for more than one factor (Fabrigar et al., 1999)

2011), it is evident that the second factor has a somewhat weaker reliability than what is recommended. However, a similar low internal reliability of their first factor in the study by Gelderman and van Weele (2005) was found to be sufficiently reliable. Hence, we argue that this is also the case in our research.

Variables affecting the factors of purchasing sophistication

We conducted an analysis of the impact on each of the purchasing sophistication factors, by the different variables investigated earlier in this chapter. The result from this investigation is now presented.

First, an analysis was done in order to see if the use of purchasing portfolio analysis affected the mean scores of the different factors of purchasing sophistication. The results demonstrated that the use of purchasing portfolio analysis gave a significant higher mean score of the second factor, skills of purchasing professionals ($t = -2.193$, SS, $p < 0.05$). However, the two other factors displayed no significant difference in mean score between users and non-users of purchasing portfolio approaches. Further, we investigated if having a purchasing department had an impact on mean scores of the three factors. The results from the analysis showed that it was only the second factor of purchasing sophistication that had a significant higher score between companies with a purchasing department compared with those without ($t = 2,720$, SS, $p < 0,01$). As we have previously established that companies with a sourcing strategy have a significantly higher purchasing sophistication, we did not see necessary to investigate this former variable's impact of the factors of purchasing sophistication.

Next, we wanted to investigate if company size and the purchasing-turnover-ratio had an impact on the mean scores of the different factors of sophistication. An analysis of both the relationship, and differences in mean score, between company size and the different factors of sophistication indicated no significant results. As such, we conclude that company size has negligible effect on any factors indicating a company's purchasing sophistication. Furthermore, through conducting a correlation analysis of the purchasing-to-turnover ratio and each of the factors indicating purchasing sophistication, no significant correlation, and consequently no relationship, between the two variables were evident.

Conclusion

In this subsection we have established that purchasing sophistication is a three-dimensional concept. Further, the results from an analysis with several relevant variables impact on the different factors of purchasing sophistication, is depicted in Figure 37.

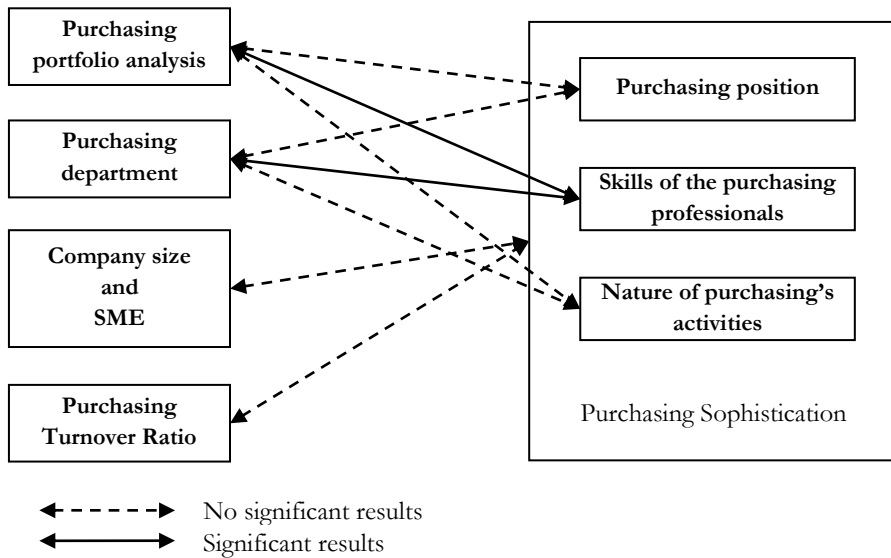


Figure 37: Variables affecting the identified factors of purchasing sophistication

From the analysis, we can conclude that it is only the second factor of purchasing sophistication, skills of purchasing professionals, which is significantly influenced. The two influencing variables are whether or not a company has a purchasing department and whether it is utilizing a purchasing portfolio approach. Next, a conclusion for section 6.4 is provided.

6.4.4 Conclusion

In this section we have analyzed several variables' impact on, and relationship with, purchasing sophistication – first as a multiple item construct, and later as a three-dimensional construct. Our findings from this part of the analysis are illustrated in Figure 38 (a solid arrow indicates a significant result, whereas a dashed arrow illustrates a non-significant relationship), revealing that companies with a sourcing strategy have a significant higher purchasing sophistication.

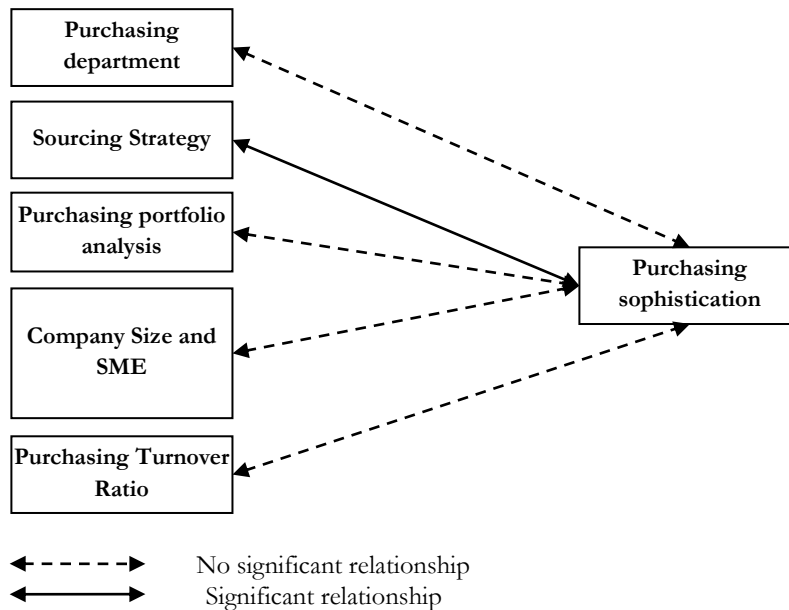


Figure 38: Variables affecting the purchasing sophistication of the purchasing function

The results from the analysis in the second part of this section is depicted in Figure 37, establishing that the skills of purchasing professionals is affected by whether or not a company has a purchasing department and if it is utilizing a purchasing portfolio approach.

6.5 Comparison of production situations

In this section, a closer investigation of the differences between production situations is presented. As ETO companies are a focus in our research, the comparison is done between ETO companies and non-ETO companies.

6.5.1 ETO companies relative purchasing sophistication

In relation to our third research question (1.2), it is of interest to establish whether ETO companies have a lower level of purchasing sophistication compared to companies in other production situations. Neglecting non-production companies, and separating between ETO companies and non-ETO companies, provided us with a sample of 39 and 40 respondents, respectively. Comparing the means of the two groups, ETO companies have a slightly lower average sophistication. However, the difference is so small that there was no significant difference between the two groups. As such, we conclude that ETO companies do not have lower average sophistication compared to non-ETO companies.

6.5.2 Comparison between production situations in relation to relevant variables

As we have compared both purchasing sophistication and the use of purchasing portfolio analysis against relevant variables, we find it beneficial to conduct the same analysis in relation to production situation. This sub-section provides the result from this analysis.

When investigating the relationship between having a purchasing department and being an ETO company, the analysis shows that a higher percentage of ETO companies have a purchasing department compared to other production companies (54.5% to 45.5%, respectively). However, this difference is not significant and there is no significant relationships between the two variables ($\chi^2 = 0.754$, NS, $p > 0.38$). Hence, there seems to be no difference amongst the production situations in relation to whether they have a dedicated purchasing department.

The analysis of the relationship between having a sourcing strategy and being an ETO company reveals that a slightly lower percentage of ETO companies have a sourcing strategy. Then again, we discover that this difference is not significant, and that there is no significant relationship between the variables ($\chi^2 = 1.141$, NS, $p > 0.28$). Thus, we can conclude that there seems to be no difference between ETO companies and non-ETO companies in relation to whether they have a sourcing strategy.

A closer investigation reveals that more non-ETO than ETO companies stated that they use purchasing portfolio approaches. However, this difference between production situations is not significant ²³($\chi^2 = 0.580$, NS, $p > 0.44$). In relation to company size, our survey data did not indicate a significant relationship between company size and production situation; even though most of the larger companies were ETO ($\chi^2 = 4.620$, NS, $p > 0.05$). This result was not surprising, considering the even distribution of ETO companies over different company sizes (Figure 33).

The only significant result discovered indicated that ETO companies had a significantly lower purchasing-to-turnover ratio compared to non-ETO companies ($t = -2.063$, SS, $p < 0.05$). The average purchasing-to-turnover ratio for ETO companies was 38.38%, whereas it was 47.12% for companies within other production situations.

6.5.3 Conclusion

In this section, an analysis of ETO companies compared to non-ETO companies was conducted. Although ETO companies have a slightly lower purchasing sophistication than non-ETO companies, this difference is not significant. Furthermore, we compared production situation to relevant variables (as done in the previous sections). The results displayed one significant finding, indicating that ETO companies have a significantly lower purchasing-to-turnover ratio.

²³ Yates' correction has been used in the computation of the chi-square statistic

6.6 Conclusion

In this chapter, we have presented findings from the survey research in relation to the ternary relationship of purchasing portfolio approaches, purchasing sophistication and engineer-to-order. With respect to purchasing portfolio approaches and purchasing sophistication, Figure 39 below shows the identified significant results between variables tested.

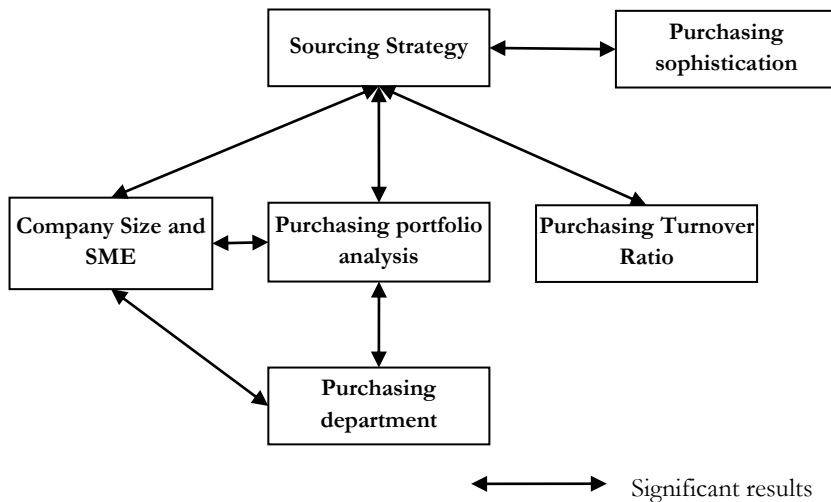


Figure 39: Connection between the sophistication of the purchasing function and investigated variables

In relation to ETO, our survey data indicated that ETO companies have a somewhat lower purchasing sophistication than non-ETO companies; however, this difference was not significant, and as such, we cannot conclude that this finding is valid in reality. Besides an identified significant lower purchasing-to-turnover ratio, we discovered no differences between ETO and non-ETO companies.

We argue that the sample utilized is suitable and without any major identified sources of bias. As such, the findings in this chapter are suitable for subsequent analysis.

7 Action research findings

In this chapter, findings from the two action research workshops with our collaborating partner company, Fugro, are provided. First, a short presentation of Fugro is given. This includes a classification of Fugro as an ETO company and motivation for choosing this company as a collaborator. The next section describes the components that were discussed in the workshops. This is followed by a section elaborating on the two workshops' process of applying the Kraljic matrix on the previously described components. Here, the company's current practice towards suppliers is also described, together with the workshop participants' evaluation of applying the model. The fourth section is organized in a similar manner as the preceding one, describing the application of the ETO adapted model developed in the specialization project (1.1.6; Figure 7). Thereafter, the workshop participants' perceptions of a purchasing portfolio approach by Olsen and Ellram (1997) are presented. This is followed by the workshop participants' total evaluation of the whole process. Finally, some concluding remarks are given.

7.1 Fugro OCEANOR – the action research collaborator

Fugro is a relatively small, high-tech company that specializes in design, manufacturing, technological development, installation and support of solutions for environmental monitoring, ocean observing and forecasting systems (Fugro, 2011a). The company is part of the Fugro Group, and is situated with its main office in Trondheim. Even though Fugro have several areas of specialization, we have chosen to narrow our scope to purchasing activities related to the design and manufacturing of buoys.

In this section, we provide a brief introduction to Fugro's production situation. Thereafter, we motivate the collaboration with Fugro in the action research. The purpose is to provide the reader with the underlying context of the workshops.

7.1.1 Fugro as an ETO company

As described earlier (5.1.1), many taxonomies and terminologies are developed in an attempt to classify production situations like ETO. In general, common denominators for ETO companies are that there is an engineering activity for each product and that the production is driven by customer orders (5.1; Table 31): Products are manufactured to meet a customer's specific needs, and therefore require unique engineering design or significant customization (Amaro et al., 1999). Consequently, the company knows very little about what to order or manufacture until a customer order is received and engineering specifications are set (Bertrand and Muntslag, 1993). These aspects are all present at Fugro; the production of a buoy is triggered by a customer order and each buoy is designed and engineered, to some extent, according to customer preferences and the specified buoy location. It is therefore argued that Fugro by definition is an ETO company. Figure 40 shows the location of Fugro's order penetration point (or CODP; 5.1) in the illustration by Olhager (2003).

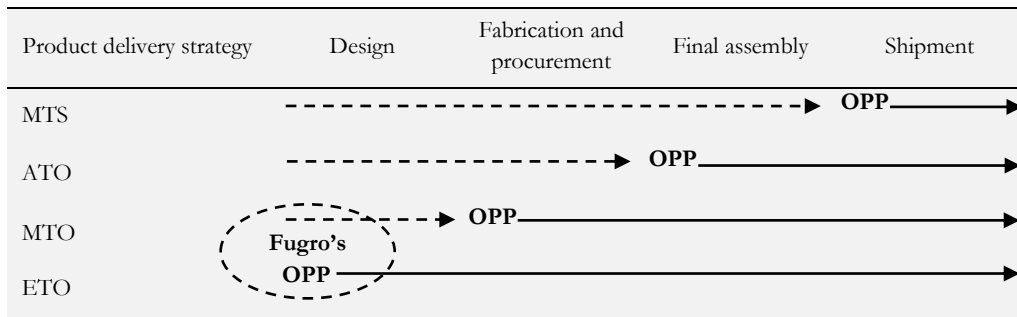


Figure 40: Fugro's order penetration point

In the specialization project (1.1.6), the authors compared the findings from a case study conducted on Fugro with identified theory on ETO (5.2). This comparison confirmed that Fugro's characteristics also correspond with ETO theory beyond the position of the CODP as shown above. This comparison is not included here; we merely acknowledge Fugro as a suitable problem holder and collaborator in our action research. The latter is further described in the next subsection.

7.1.2 Collaboration with Fugro in action research

As mentioned in the introduction (1.1.2.), Fugro is chosen as a collaborative partner due to its engineer-to-order production situation. The MARGIN research project is partially financed by the collaborating partners; therefore, value for the participants is a stated goal of the project. As such, the purpose of the action research is not only for the authors to learn about purchasing portfolio approaches' value and implications beyond what could be identified in theory, but also for Fugro to get an introduction to purchasing tools that possibly could be of value for the company, referring to the dual aspect of action research (2.3.3).

7.2 Components to be tested

In the case study of Fugro conducted fall 2011 (1.1.6), we got an impression of which components a buoy typically consists of. As such, we were able to choose buoy components that Fugro could position in the selected sample of purchasing portfolio approaches during the action research. We did, however, not possess deep insight in the components' characteristics prior to the action research workshops. Hence, before positioning the components, Fugro described each component in more detail. This description is summarized in Table 46 for the reader's convenience. Symbols that are utilized later, in illustrating the final positioning of the components, are also included.






Component	Description	Symbol in the matrices
Anchorage system	The anchorage system is a prerequisite for keeping the buoy in position. It varies with depths of the ocean and current conditions; as such, it is engineered for each buoy. The anchorage system consists of several common components; plumb, chain, rope, wire and a float ball. In order for the buoy to make valuable measurements, it is important that it can operate within a certain radius of action. As such, the anchorage system is “much more than merely tying a rope to a plumb”.	
Shell	The shell (or floater) is the component that one would typically associate with a buoy. It is manufactured in a rather delicate rotational casting process. Fugro own the casting mold used in this process. The buoy’s components are installed on, or within, the floater.	
Inertial sensor	The inertial sensor is a fairly standard product that is included in each buoy. It is designed by Fugro, while the production itself is outsourced. The inertial sensor consists of a circuit board with three axiometers that measure acceleration and rotation in three axes. The combination of an inertial sensor and a data logger is typically referred to as “wave sensor”.	
Data logger	The data logger is the “brain of the buoy”. It is an electronic unit that transfers digital measurements from the buoy’s sensors to the mainland. It is designed by Fugro, while the production itself is outsourced. Without this unit, the buoy is not functional.	
Battery pack	The battery pack is located inside the shell, and has two functions; powering the electronic devices and functioning as a plumb. It consists of either lead or lithium batteries, or a combination of these, depending on the customer’s requests and light conditions in the area of operation. The latter refers to the fact that the lead batteries are charged by solar cell panels.	

Table 46: Description of components

In the next section, an elaborate description of the process of testing these components in the Kraljic matrix is provided.

7.3 Applying the Kraljic matrix

In this section, we present our application of the Kraljic matrix²⁴. In the first subsection, the process of positioning the above mentioned components in the Kraljic matrix is provided. Observations made in the process are explicitly formulated²⁵, referring to the research interest of the action research (2.3.3). The observations made will be utilized in Part III of this master’s thesis (analysis and discussion). The components are granted individual paragraphs, where the first workshop’s positioning is described first, followed by the second workshop’s positioning. The first workshop comprised Purchaser A and Purchaser B, whereas the second workshop comprised E1 (employee from engineering) and SM1 (employee from marketing/sales) (2.3.4).

²⁴ Actually, a further development of the Kraljic matrix was utilized, because it provides generic strategies for all quadrants; not only the strategic one (3.4.1). We will only refer to it as the ‘Kraljic matrix’.

²⁵ PPA_Observation_#, ETO_Observation_#, PS_Observation_# and AR_Observation_#, for PPA, ETO, purchasing sophistication and action research, respectively.

A concluding paragraph illustrates each of the workshops' positioning of the components in the Kraljic matrix. In the proceeding subsection, a presentation of today's purchasing practice towards suppliers is presented. This is followed by a subsection describing the problem holders' and researchers' evaluation of the use of the Kraljic matrix.

7.3.1 The positioning process

As described in the methodology chapter (2.3.4), we used an action research protocol when conducting the workshops with Fugro. This protocol functioned as a game plan, in that it was used to structure the workshops. We were, however, conscious in allowing discussions to follow a "natural flow", in order to prevent the risk of missing out on valuable information. As described in the protocol (A.2), after introducing ourselves, we presented the Kraljic matrix together with its intention, dimensions and an example of its use with a fairly known product; ballpoint pens. The problem holders were then challenged to discuss and place the aforementioned components in the Kraljic matrix.

Positioning the anchorage system

The first component to be addressed was the anchorage system. In the *first workshop*, Purchaser A initiated the process by, more or less systematically, addressing the underlying measures of the model's dimension²⁶. He first evaluated the cost of the anchorage system, arguing that it constitutes a relatively low share of a buoy's total costs. With respect to product quality, he argued that "the anchorage system is necessary in order to keep the buoy from drifting; if we sell a buoy, an anchorage system is a prerequisite". Purchaser A then deviated from the measures, and started evaluating to what degree Fugro can reap profits from the component, referring to the corresponding profit impact dimension itself: "We cannot put a high price on it (the anchorage system), because it consists of components that are available all over the world. The customer can check the costs of 1000 meters of rope, shackles and stuff like that; relatively simple, verifiable components. We cannot make a profit on the anchorage system". Based on this unexpected turn, we make the following observation:

PPA_Observation_1 It is not clear whether one should only evaluate the underlying measures of the model's dimension, or whether the dimension itself can be utilized as a measure.

Purchaser A then proceeded to evaluate the supply risk measures. First, he stated that there are many available suppliers for the anchorage system. He then explained that they are currently using one supplier; "however, we can use many suppliers of anchorage systems; we can easily change to other suppliers". Purchaser A did, however, not continue with the evaluation of the supply risk measures on his own. As such, we saw it necessary to follow up by asking questions related to the measures. We make the following observation:

²⁶ The matrix, with its dimensions and underlying measures, was displayed at a screen during the entire process. For the measures, the reader is referred to appendix A.2 (action research protocol).

AR_Observation_1 The participants of the workshops tend to hesitate, and await guidance from the researchers.

First, we asked if the systems are purchased to stock. Purchaser A replied that “today, we purchase close to nothing to stock, we order for each contract”. Further, we wanted to know the supplier’s role, in order to evaluate the make-or-buy measure of supply risk. Purchaser A explained that Fugro design the anchorage system, whereas the production itself is outsourced. The current supplier used to supply components earlier, when Fugro used to make the anchorage system themselves. Fugro still have capabilities to do so; however, from a cost perspective, they have found it more lucrative to outsource the production. According to Purchaser A, “we have assessed the situation, and found that due to space required for ropes and such, it is better that our supplier keeps stock for us and produces anchorage systems to order. That is what is happening today”. As such, Purchaser A also addressed the risk of keeping stock, which is a measure underlying the supply risk dimension.

At this moment in the process, we noticed that purchaser B was quiet and did not participate actively in the discussion. When asked if he had anything to add, he replied that “for the anchorage system, I have nothing to add”, and was eager to proceed to the inertial sensor. We knew, based on the case study of Fugro conducted fall 2011, that purchasing responsibility is divided between three purchasers. Purchaser B is responsible for purchasing electrical equipment. As such, he did seemingly not consider himself to be capable of providing valuable input in the anchorage system discussion. We make the following observation:

PPA_Observation_2 Portfolio analysis participants may be passive (for whatever reason) when components that are not “their responsibility” are evaluated.

In order to reach a conclusion, we asked the purchasers to position the anchorage system in the Kraljic matrix. They then became hesitant; as such, we saw the need to recapitulate their answers, and propose that the profit impact and supply risk scores, in summary, were low and low, respectively. Purchaser A nodded his assent, whereas purchaser B remained silent. Consequently, the anchorage system was positioned in the *noncritical* quadrant of the Kraljic matrix. Again, we see that AR_Observation_1 applies, in that the researchers had to lead the discussion.

In the *second workshop*, SM1 started by explaining that the anchorage system is engineered by Fugro based on input from the customer, and is then ordered from the supplier. Fugro use tailored software to calculate specifications according to waves, depths and current conditions in each buoy’s area of operation. As such, many factors determine the resulting anchorage system. SM1 explained that the procedure is that he receives characteristics of the buoy’s area of the operation, which is forwarded to E1, who designs the anchorage system. This design is then sent to Purchaser A, who provides the supplier of the system with the specifications. Again, we saw

the need to guide the discussion towards the measures constituting the dimensions of the model. This may bear resemblance to our first AR observation; however, it somewhat deviates in that the participants are derailing instead of hesitating. We make the following observation:

AR_Observation_2 The participants of the workshops tend to deviate from the positioning process, and discuss other aspects than the positioning of the component.

To continue the process, we then asked how they evaluate suppliers in the specification process. They confirmed what Purchaser A previously stated; they use one supplier that produces according to the specifications provided by Fugro. We proceeded by asking if it would be easy to change from the current supplier to a new supplier, referring to the possibility for substitution, which is a measure of the supply risk dimension. E1 argued that “It is not just a piece of cake, because they deliver an assembled system. Earlier, we bought only ropes and assembled the system ourselves. Then we could approach several suppliers. Now, work practices are important for the anchorage system. It is not that many suppliers who can do this. A lot depends on the person that is doing the job”. We make the following observation:

ETO_Observation_1 The suppliers’ work practices limit the number of available suppliers, due to their effect on the product quality.

With respect to the evaluation of available suppliers, SM1 made an interesting statement: “I immediately thought of this as noncritical, but it is more critical if you talk about changing supplier”. We make the following observation:

PPA_Observation_3 Users may end up discarding initial thoughts when evaluating aspects not considered previously.

SM1 and E1 then evaluated the anchorage system’s share of total product cost. SM1 estimated that it corresponds to about 10 % of the buoy’s total costs. According to E1, “it depends, you know. Sometimes we deliver 300 meters, in, for example, India we deliver 5000 meters”. We make the following observation:

ETO_Observation_2 Components that are made specifically to order may vary in price, and, as such, profit impact.

Thereafter, SM1 was quick to position the anchorage system in the bottleneck quadrant. We explained the bottleneck quadrant to check if he was certain about this choice, whereupon he confirmed his positioning. In line with PPA_Observation_3, we proceeded to steer the discussion to the measures of the supply risk dimension, to see if a more thorough evaluation

would lead to yet another positioning. As such, we asked the participants if they felt that they have a good overview of available suppliers. Both SM1 and E1 felt that Fugro are aware of available suppliers. This did not alter the participants' evaluation of the anchorage system, which in the second workshop ended up in the *bottleneck* quadrant. This concludes the positioning of the first component. In the next paragraph, the inertial sensor is subject for investigation.

Positioning the inertial sensor

When positioning the inertial sensor in the *first workshop*, one challenge immediately appeared. There seemed to be discrepancy related to the term “inertial sensor”; Purchaser B questioned whether the inertial sensor was “the axiometers that is placed...?” whereas Purchaser A made a follow-up by saying “the wave sensor, for certain”. After a brief discussion, we came to the conclusion that an inertial sensor consists of a circuit board with three axiometers, and that the combination of an inertial sensor and a data logger is typically referred to as a “wave sensor”.

According to Purchaser B, the axiometers are off-the-shelf products that are purchased in relatively large quanta, immediately indicating a somewhat high profit impact. With reference to the wave sensor unit, Purchaser B evaluated the profit Fugro can reap from it, at an early stage of the discussion: “We can reap a large profit from it, because the wave sensor is designed for our purpose, focusing on low power consumption”. As such, we see that PPA_Observation_1, as made in the positioning of the anchorage system, applies.

In order to further investigate the supply risk dimension, we proceeded by asking about the suppliers of inertial sensors. According to Purchaser B, there are quite a few suppliers of the circuit board, which is designed by Fugro. Referring to the availability measure of the supply risk dimension, he further added that several of these are possible to use. There are fewer suppliers of the axiometers, due to strict specifications set by Fugro; consequently, there are more available suppliers if one were to lower the specifications. We then wanted to know about the cost of the inertial sensor, and its effect on product quality, referring to the profit impact dimension. Purchaser B replied that it is relatively cheap, and that it is not very critical; “if the sensor fails, the data logger will still work, and other measurements will still be made”. Purchaser A added that if you are to measure waves, it is important. When asked if the inertial sensor is a competitive edge, Purchaser B replied that it is. We recognize a pattern of us driving the discussion forward, which corresponds with AR_Observation_1.

We further asked about the ease of changing suppliers in order to further investigate the supply risk of the component. Purchaser A stated that one would have to adapt quite a bit in order to use axiometers from other suppliers; “it is critical if they stop producing a sensor, it takes time to adapt a new type of sensor. It is not straightforward to change supplier, it would be like buying coarse-grained flour to make wholemeal bread”. Purchaser B agreed, stating that they would have to adapt with respect to both hardware and software. We make the following observation:

ETO_Observation_3 Some sourced components are considerably integrated in the final product; consequently, the transaction cost of changing components or suppliers may be high.

Next, we asked where in the matrix the inertial sensor would fit. Purchaser B again argued that that it scores high on the profit dimension, because it is specially made for Fugro; enabling a higher profit than what is the case for the anchorage system. Again, Purchaser B evaluated the dimension itself, corresponding to PPA_Observation_1. He continued by repeating that there are quite a few suppliers of the circuit board, whereas there are fewer available suppliers for the aximeters. He did not position the inertial sensor after making these arguments; however, based on these answers, we suspected that the inertial sensor could be placed in the leverage quadrant. In order to challenge AR_Observation_1, we did not want to reveal our suspicion about the positioning, but rather challenge this implicit conclusion.

Consequently, we asked about what a buoy typically costs. According to Purchaser B, it depends on what it is equipped with, but provided a typical price range. We then asked how much the inertial sensor costs; whereupon Purchaser B gave an answer considerably lower than the buoy price. We then confronted the purchaser, implying that if this is doubled, the inertial sensor still has a small impact on total product cost. Purchaser B then provided the margins reap from the component²⁷. We observe that PPA_Observation_1 yet again applies, in that Purchaser B evaluated the dimension itself, rather than its measures. Purchaser B did, nonetheless, add that “for the entire system, it is a small cost”. As such, he moderated himself with respect to the profit impact, and lowered the profit impact of the inertial sensor. We observe that PPA_Observation_3 applies.

We then asked explicitly about the supply risk, and recapitulated previously stated arguments. Purchaser B made the following comment: “As I said, the inertial sensor consists of several boards (circuit board with aximeters). For one of the boards (the circuit board), there are many suppliers; for the other boards (aximeters), there are fewer suppliers. So...” We make the following observation:

PPA_Observation_4 Complex product structures make the positioning of components difficult.

We proceeded to investigate the supply risk by asking whether they do have alternative choices of suppliers, whereupon Purchaser B confirmed that “yes, we have choices”. We also asked if they purchase to stock, and Purchaser B replied that “yes, we have some in stock; there is no risk associated with that”. We saw that we would end up in the same quadrant as for the anchorage system, and asked the purchasers whether or not they agreed. Purchaser B replied “yes”. We conclude that the first workshop positioned the inertial sensor in the *noncritical* quadrant, and make the following observation:

AR_Observation_3 The researchers have great influence on the problem holders; the problem holders tend to reply confirmatory to leading questions.

²⁷ The details of this discussion are left out due to the sensitive nature of the information.

In the *second workshop*, there was also discrepancy with respect to the inertial sensor. Somehow, the discussion did not solely focus on the inertial sensor, but also on the wave sensor. From there, it derailed to a discussion about the data logger. This is further described below.

First, we initiated an evaluation of the supply risk by asking about the availability of axiometers, i.e. if they are readily accessible. According to E1, “there are very few who match the specifications set by Fugro. As such, it is critical”. SM1 added that they are dependent on low power consumption, as the buoy is powered by batteries. According to E1, they purchase large quantities to stock, and buy 3-400 units if they hear that the components are to be phased out of production. This is done, according to SM1, because the wave sensor has to be redesigned if the components in it change, in order to deliver according to the specifications promised to the customer. This is in accordance with ETO_Observation_3 made in the first workshop.

There was still uncertainty about what the participants regarded as the inertial sensor; as such, we wanted to clarify this before attempting to position the component. We therefore asked about which components constitute a wave sensor. SM1 answered that “the wave sensor is a combination of the data logger and a board that constitutes the wave sensor. The wave sensor is a circuit board. If you buy a data logger, you remove the wave sensor (board). The wave sensor runs via the data logger, it is assembled in the same chassis”. E1 clarified this, and provided the following relationship: “Inertial sensor plus data logger equals wave sensor”. We proceeded to ask where it fitted in the model. SM1 immediately stated that he was not comfortable with the leverage quadrant, and that “our data logger is what the concept is built around. So, it is at least strategic”. E1 confirmed that it is one of the “core systems”. We see that not only did SM1 position the product without considering the dimensions or the dimensions’ measures; he also positioned another product than what was being analyzed. We make the following observations:

PPA_Observation_5 The names of the quadrants in the model may lead to predisposition with respect to positioning, omitting the dimensions and their measures.

PPA_Observation_6 Complex product structures may make the discussion derail from the actual component in analysis.

The discussion that followed concerned the data logger; hence, this is postponed to the paragraph where we describe the positioning of this component. As such, the participants in the second workshop never explicitly positioned the inertial sensor. Based on our observation, we feel, nonetheless, that we have a fairly good basis for positioning the component in the model. We assume that their assessment of profit impact would correspond to the purchasers’ assessment. However, we argue that given their supply risk assessment, the participants in the second workshop regard the component as a bottleneck item. We feel that this assumption is

legit by virtue of the problem solving interest of action research (2.3.3). In the next paragraph, the positioning of the shell is described.

Positioning the shell

In the *first workshop*, Purchaser A started the process by providing a thorough description of today's practice concerning the shell. This revealed that they are currently using one supplier, of which he had extensive knowledge. This supplier keeps a certain stock for Fugro. He then evaluated the impact on total cost, stating that the shell does not constitute a large share. In order to measure the competitive demand of the component, we asked whether the supplier has many customers buying these shells, or if Fugro is the supplier's only customer of these products. Purchaser A then confirmed the latter.

In order to assess the possibilities for substitution, we challenged Purchaser A to consider what the alternatives were, if they were to lose their single supplier. Even though Fugro own the unique casting molds used to make the shells, it is not easy for them to change suppliers; Purchaser A stated that "we need to go to England for a new supplier". However, the company was in a process of assessing whether this supplier in England was capable of being an alternative supplier. Purchaser B stated that this supplier needs to prove that it is able to produce the components according to the requirements stipulated by Fugro. We see that ETO_Observation_1 applies.

In order to reach a conclusion, we had to encourage the purchasers to place the shell component in the matrix; corresponding to AR_Observation_1. In an attempt to evaluate supply risk, Purchaser B stated that there were risks associated with the product; however, he did not place the product. We then proposed that the shell component may be classified as a bottleneck product, in which the purchasers agreed. This is in line with AR_Observation_3. In addition, Purchaser B did not actively participate in positioning this sourced product; as such, this reinforces PPA_Observation_2. Purchaser A added that their supplier claims to be the best in the world on the required rotational casting process, indicating a high supply risk.

In the *second workshop*, E1 demonstrated that he possessed detailed knowledge of the sourcing practice of this component. However, in contrast to the previous workshop, E1 emphasized, on his own initiative, the cumbersome task of changing supplier; "It takes half a year to go from prototype to series production; it is not done in the blink of an eye". SM1 stated that this development process goes through several iterations, each with a new prototype of the shell. E1 repeated that there is some risk associated with changing supplier. In comparing the two workshops, it is apparent that engineering may be more conscious with respect to the transaction cost associated with a change of supplier. We make the following observation:

PPA_Observation_7 Portfolio analysis participants from non-purchasing functions provide valuable information, not only in placing the sourced component, but also concerning the transaction cost of changing today's practice.

The discussion somehow derailed towards lead time of the shell component. This then evolved into a discussion on cross-functional collaboration. SM1 stated that they have a lot of contact with the engineering department, as they need their consultation in order to derive the time of delivery of the final product. E1 added that this collaboration depends on which type of buoy they are to deliver; special sensors entail more interaction. In addition, E1 explained that “we work closely because we are close”. Hence, we make the following observation:

ETO_Observation_4 Co-location of functions at the same premises enables face-to-face interaction, which may compensate for the need for cross-functional integration.

SM1 proceeded by explaining the nature of this interaction when writing a tender: Marketing and sales use a software program when they write a tender; however, it does not function as intended. This forces them to interact with the engineering department. SM1 proceeded by stating that “the ideal for us is to have less to do with each other, and rather have engineering provide updated information in the software, which we then could extract”. We make the following observation:

ETO_Observation_5 There seems to be little appreciation for the benefits of cross-functional coordination; if employed software works as intended, this coordination would not be necessary.

We found this interesting, and asked to which extent a lack of technical insight was a problem for sales and marketing personnel. E1 replied that “they do not have the same technical insight; however, this has never been a problem”. SM1 proceeded by stating that they have become better at checking with other departments before making any promises to the customer. Nonetheless, SM1 further stated that “we sometimes discuss ‘why we have done this again? – we knew that this was a poor solution’”. According to SM1, this has usually happened when marketing and sales did not have sufficient time to contact the other departments. We make the following observation:

ETO_Observation_6 Lack of cross-functional coordination may lead to poor performance when promises are made to customers.

Further, E1 argued that since they are a small company, they do not have dedicated purchase-, engineering- or sales personnel; one often works in two departments at once. E1 added that several workers at Fugro have worked within more than one department. As such, they possess knowledge beyond what is their daily responsibility. We make the following observation:

ETO_Observation_7 For a small company, the facets between the different departments (such as purchasing and engineering) may be vague, and one often finds oneself working for several functions at once. As such, an employee may possess thorough knowledge of several functions.

We then urged the participants to position the component. SM1 stated that the component has a low supply risk, as it the supplier is well known and stable. E1 added that the product had a low profit impact, as it had a low share of total cost. Further, unlike SM1, E1 repeated that there is supply risk associated with the possibility of losing their single supplier, and argued that it would take a long time before Fugro could deliver buoys if they were to change supplier. This argumentation, made SM1 change his initial assessment of the components supply risk, and argued that it should be placed somewhere between the non-critical and bottleneck quadrant, with an emphasis on the latter. We make the following observation:

PPA_Observation_8 An initial evaluation of the dimension alone may be substantially altered as one considers its underlying measures.

Positioning the data logger

In the *first workshop*, Purchaser B initiated the process by explaining that the data logger constitutes just a fraction of the total product cost; however, it is a very important component. It is the brain of the buoy, as it gathers data and transfers it to shore. He further elaborated that there are several available suppliers for production of the data logger, which is designed by Fugro. They are currently using one local supplier, and are aware of two other local suppliers that can do the same job. As such, he evaluated the supply risk as low.

Purchaser B proceeded to explain that they order quite a few units at a time; “there is no risk in doing this, because every buoy contains a data logger. In addition, there is demand for spare parts”. We then asked how easy it would be to change supplier, whereupon Purchaser B answered that “we can change supplier tomorrow if we want to”. We followed up on this statement, and asked how long it would take for a new supplier to be put into effect, and whether a supplier must possess a certain competence. This was done in order to challenge PPA_Observation_8, and to achieve better comprehension of the supply risk. According to the purchasers, the suppliers are familiar with the required type of production, and the only time needed is the lead times for the circuit boards; approximately eight to ten weeks. We then had a follow-up question, asking if there are any specific components in the data logger that could be difficult for a new supplier to obtain. According to Purchaser B, this is not a problem, as the component solely consists of standard components. The only recent problem with respect to supply was caused by the tsunami in Japan, which destroyed electronics factories. As such, we see that PPA_Observation_8 does not apply here.

In order to facilitate the discussion towards a conclusion, we asked where the data logger would fit in the matrix. According to Purchaser B, “it is a small share in terms of costs, but we can reap

large profits from the unit. But in the whole, it drowns...” Again, we see that Purchaser B refers to the profit impact itself, instead of the dimension’s measures. This corresponds to PPA_Observation_1.

The process then, in line with AR_Observation_2, deviated slightly, in that the purchasers described the supplier’s production process, and explained how the data logger is stacked together with the earlier treated inertial sensor. As such, we saw the need to intervene by asking a series of questions related to various measures of the dimensions. These revealed that the data logger is purchased in relatively large quanta when it is purchased. It constitutes a small amount of the buoy’s total cost; however, it has high influence on product quality. There are several available suppliers and there is no risk in keeping stock. Hence, the purchasers positioned the data logger in the leverage quadrant.

As mentioned previously, the *second workshop’s* evaluation of the data logger followed from the discussion of the inertial sensor. According to SM1, the data logger is expensive, and they do not want to keep large stock. We then asked how many suppliers there are. E1 responded that they buy sensors everywhere, and integrate these themselves. As he was not answering the question, we explicitly asked them to evaluate the dimensions’ measures, trying to avoid the tendency observed in AR_Observation_2. SM1 then replied that there is high supply risk due to few available suppliers and a high cost of keeping a large stock. According to E1, the profit impact is high due to the cost of the data logger component and its high impact on quality. Consequently, the second workshop positioned the data logger in the strategic quadrant.

Positioning the battery pack

The last component to be placed in the workshops was the buoy’s battery pack. In the *first workshop*, Purchaser A initiated the process by giving a description of today’s purchasing practice for this component. He further explained that the battery pack is identical for two of Fugro’s products. As such, there is no risk in keeping stock; implying a low supply risk. The discussion further revealed that the battery pack may actually consist of both lead and lithium batteries, depending on the buoy’s area of operation. According to Purchaser A, there are several suppliers of lead batteries; however, the lithium batteries are designed especially for Fugro by a supplier in France.

After providing a thorough description of the company’s current purchasing practice towards their supplier of both lithium and lead batteries, we felt that we had to facilitate the conversation towards placing the battery pack in the purchasing portfolio matrix. This was done by asking the purchasers about several of the measures determining profit impact and supply risk. In addition, we had to summarize their arguments and provide suggestions to an overall placement along each dimension. In doing this, we saw that both AR_Observation_1 and AR_Observation_3 were prevalent, in that the participants awaited guidance and replied confirmatory.

Both purchasers agreed that the lithium batteries were a strategic item. Purchaser A stated that the battery package is not a complex unit; “the technology is known, however, safety is important when sourcing batteries, as it is very risky to neglect”. He further explained that the required level of quality determined which battery cell to use, and that the factory in France was

the only provider of these cells. This assessment of the possibility for substitution raised the supply risk of the component. The battery pack was then positioned in the strategic quadrant, based only on the discussion concerning the lithium batteries. As such, the lead batteries seemed to be forgotten. This supports both PPA_Observation_4 and PPA_Observation_6.

In the *second workshop*, we divided the battery pack in two separate components; lithium and lead batteries. This was done with the purpose of avoiding the occurrence of PPA_Observation_4 and PPA_Observation_6; as the previous workshop had difficulties in placing the battery pack as a whole. As with the first workshop, both E1 and SM1 explained that the configuration of the battery pack was dependent on the location of the buoy. SM1 continued the discussion by stating that the company has high requirements in relation to the safety of the components constituting the battery pack, which again reduces the number of potential suppliers; reflecting ETO_Observation_1. E1 further added that even though they have some lithium batteries in stock, they would rather not have a large stock, because it ties up capital.

In order to facilitate the conversation towards a placement of the products, we asked where they would place the product. However, with little response, we tried to summarize previous arguments and have the participants agree or disagree; corresponding with AR_Observation_1 and AR_Observation_3. This made us reach a conclusion together, without effort, classifying the lead batteries as non-critical and lithium as strategic. Immediately, it seemed beneficial to divide the battery pack in its two main components; lead and lithium batteries. We make the following observation:

AR_Observation_4	Experiences gained earlier in the process may be utilized with success at a later point; enhancing both the research and problem solving interest.
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In the next paragraph, the participants' positioning of the components is illustrated in the Kraljic matrix, concluding this section.

Resulting positions

We here present two Kraljic matrices (Figure 41), with components placed for purchasing and marketing/sales and engineering, respectively. The symbols in the matrices correspond to the description in Table 46.

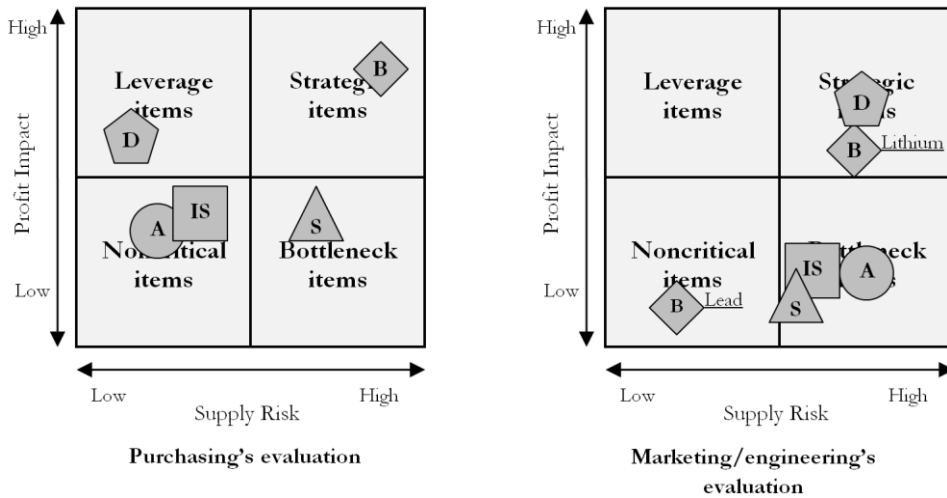


Figure 41: Kraljic matrices with positioning of components

With respect to Figure 41, we see that the two workshops have positioned the products differently. Based on the illustration, we will now make some immediate considerations. First, it is worth mentioning that the workshops' evaluation of the profit impact are more or less identical, whereas sales/marketing and engineering evaluate the risk to be higher than what was evaluated by the purchasers. As such, perceptions of supply risk cause the differences in Figure 41. Second, the shell and battery pack are the only components that ended up in the same quadrants. For the other components, there is no consensus; this may imply that a discussion with several functions gathered could reveal important aspects. Finally, we see that the second workshop did not position any components in the leverage quadrant. This may be caused both by a consequent higher risk evaluation and a predisposition concerning the leverage quadrant (which provided a basis for PPA_Observation_5).

Next, we provide an overview of today's practice towards suppliers.

7.3.2 Today's practice

After placing the components in the Kraljic's matrix, the intention was to have the workshop participants provide a description of today's sourcing practice. However, during the process of positioning the investigated components, this information emerged as an obvious consequence of the discussion. As such, we asked only about certain elements that were still unclear. This was done with the intention of enabling a comparison of this practice with strategies recommended from purchasing portfolio approaches. Today's sourcing practices with respect to the components in question are summarized in Table 47 below.

Component	Today's practice
Anchorage system	<p>The company uses one supplier, which was chosen due to proximity, good communication, and stability over time. In addition, a long term relationship with the suppliers has been natural to prolong, even though the nature of the relationships changed. This was illustrated by a statement made by SM1; “we have worked with the supplier for a long time, because they supplied ropes when we made the anchorage system ourselves. Hence, it was natural to work with them, as they supplied many of the components initially”.</p> <p>The anchorage system is not kept in stock; it is engineered depending on where the buoy is to be located. Consequently, the production is postponed until the customer can specify this location, whereupon Fugro communicate these specifications to the supplier.</p> <p>Fugro do not want to rely solely on one supplier, and are currently gathering price information from an English supplier that Fugro GEOS, a sister company, is using.</p>
Shell	<p>Fugro use one supplier, which they have long experience with. This is the only Norwegian supplier capable of performing the required rotational casting process. However, they are currently working on finding alternative suppliers. In this respect, they have located a potential English supplier on which they are gathering additional information.</p> <p>As their single supplier also delivers to other Fugro Group subsidiaries, a framework agreement with the supplier has been negotiated. This framework agreement determines price, and states that the supplier should keep a certain level of stock. In addition, Fugro own the casting mold that the supplier uses to produce the shells.</p> <p>Fugro have extensive knowledge of the supplier's operations. This was illustrated by statements such as “they are able to work three shifts” and “they want to produce a certain amount of shells when they initiate production, as there are some start-up costs”. In addition, Purchaser A was able to elaborate on the production process and which parts of the shell that were especially difficult to fabricate; “our second largest buoy is the most labor-intensive, with over 300 parts to be placed before casting”.</p>
Inertial sensor	<p>Fugro use one local supplier for the circuit board, which they have a good communication with; they are on a first-name basis with several employees at the supplier's. Fugro know that there are at least two other local suppliers that can do the same job. As such, they can, and do, obtain lower prices by changing supplier.</p> <p>The company purchases relatively large quanta to stock in anticipation of future orders, and have approximately five to ten units in stock at all times. As such, marketing can tender for orders containing three to five sensors without conferring with purchasing personnel.</p>
Data logger	<p>Fugro are currently using one local supplier for the data logger, and keep some stock due to long lead times. They order a relatively large quantum at a time. This has no risk, due to the data logger's presence in each buoy. Fugro also need to keep some in stock due to spare parts agreements.</p> <p>When choosing a new supplier, they use a tendering process; however, the agreement for supply is not regulated by contract – this is due to the perceived low supply risk. Purchaser B stated that “we can change supplier tomorrow”. Low price and delivery time are most important when choosing a supplier. However, the setup-time for the new supplier, given that Fugro change supplier, is approximately 8-11 weeks.</p>

Component	Today's practice
Battery pack	<p>Fugro are currently using one local wholesaler of lead batteries and one supplier in France for lithium batteries. Fugro keep about 10-20 lead batteries and 10 lithium batteries in stock. Lead batteries are ordered through Microsoft Dynamics (ERP system) with a reorder point of ten units. In addition, the supplier keeps a certain stock of these components.</p> <p>The lithium batteries have a lead time of about 10-12 weeks, and are custom made for Fugro. The latter entails that the French supplier cannot sell these battery cells to other customers. In addition to being 40-50% cheaper than local suppliers, the supplier of lithium batteries is one of the world's largest manufacturers, and is the only supplier capable of making the lithium batteries in accordance with Fugro's strict safety requirements. When asked if it was realistic to initiate a strategic collaboration with this supplier, Purchaser A stated that they had little impact on the supplier's production; "we are treated as a small supplier". However, Purchaser A admitted that they had to resort to a local supplier when they could not wait for the French supplier to provide the batteries.</p> <p>There are no contractual agreements with the battery suppliers.</p>

Table 47: Today's practice

Based on the description of today's practice (Table 47) we were able to derive the following observations:

ETO_Observation_8	Proximity, stability and good communication are preferred characteristics of supplier relationships.
ETO_Observation_9	A long-term relationship may be natural to prolong, even though the nature of the relationship changes.
ETO_Observation_10	For several of the sourced components there exists no contractual agreement with the supplier.
ETO_Observation_11	The company searches for alternative suppliers, in order to establish alternatives and as a means for comparing prices.
ETO_Observation_12	A long-term relationship with a supplier may lead to the development of valuable knowledge of the supplier's operations.

In the next subsection, the problem holders' and researchers' evaluation of using the Kraljic matrix is presented.

7.3.3 Evaluation of applying the Kraljic matrix

As described in the action research protocol (A.2), we asked the workshop participants to evaluate the application of the Kraljic matrix prior to the positioning process. We first present the participants' evaluation of the process, before continuing to our own evaluation of the process.

The problem holders' evaluation

In the *first workshop*, we asked the purchasers if they found it beneficial to evaluate components using such a framework, or if it concerned matters that they are already aware of. Purchaser A replied that they generally have a good overview; "however, we learn a lot". He stated that it is valuable to get input, and found it informative. He acknowledged that they are doing many things right; "we see that what we are doing, people have thought of before". Purchaser B added that "when we have audit, we are reminded by the auditor that there are alternatives; to not lock with one supplier and things like that".

We further stated that there is a latent risk in shopping around without having contract agreements with suppliers, referring to ETO_Observation_10. We argued that when they choose to shop around, they lose some of the commitment the suppliers may have had if contractual agreements were in place. As such, the suppliers may be as opportunistic as Fugro are today, cf. ETO_Observation_11, when they get orders from other customers. We added that their small size would not benefit them in such a situation. Purchaser B acknowledged this; "we are very small, really". We emphasized that these are things one have to consider; which suppliers to commit to, length of the relationship, and so on. Purchaser B replied that "it is a lot to think about". We added that when you are familiar with the supplier, and are on good terms with him, you would possibly have an advantage over other customers. As such, it may be wise to weigh the pros and cons, and not necessarily choose the cheapest there and then, but think ahead. According to Purchaser A, this coincides with their thinking. It should be mentioned that this was not meant as critique of the problem holder; we were merely giving food for thought with the best intentions – coinciding with the problem solving interest of the action research (2.3.3).

In the *second workshop*, we began the evaluation in a similar manner as we did in the first workshop. It became apparent that the feasibility of purchasing portfolio approaches was questioned, as the problem holders had varying experience with implementing practice proposed by academics. According to SM1, "we have seen many models through for instance lean, but it is hard for us to adopt such a system, as many of the systems are made for companies with big production lines with high volumes. We do not have that, and as such, the models tend to be redundant. We have used 5S²⁸. We have implemented some phases. We cannot implement and use everything". As such, the feasibility and relevance of purchasing portfolio approaches were questioned. We make the following observation:

²⁸ 5S is a lean manufacturing technique, and refers to Shine, Sort, Straighten, Standardize and Sustain.

PS_Observation_1 Participants have predispositions regarding models proposed by academics; they do not fit their unique production situation (e.g. having low production volumes).

The researchers' evaluation

After having both workshops use the Kraljic matrix, we discovered that some measures underlying the two dimensions in the model were seldom used, whereas others were used more often. Especially, impact on business growth was ignored by the workshop participants; it was not evaluated once during both sessions. Hence we make the following observation.

PPA_Observation_9 Impact on business growth was never used to evaluate the profit impact of a product.

Further, we discovered that the measure of supply risk concerning the possibilities for make-or-buy was not evaluated, unless we explicitly asked the participants about it (as in the first workshop). Hence, we make the following observation.

PPA_Observation_10 Make or buy opportunities were not evaluated without being prompted.

In the next section, we apply an ETO adapted model in a similar manner as to what was described in this section.

7.4 Applying the ETO adapted model

As described in the action research protocol (A.2), we wished to test and use the ETO adapted purchasing portfolio model that was developed in the specialization project (1.1.6; Figure 7). The use of this model is described in this section. First, we present the process of positioning the selection of components (Table 46). As for the application of the Kraljic matrix, observations made in the process are explicitly stated²⁹. A concluding paragraph illustrates each of the workshops' positioning of the components in the ETO adapted model. This is followed by a subsection describing the problem holders' and researchers' evaluation of the use of the ETO adapted model.

7.4.1 The positioning process

As for the Kraljic matrix (7.3), we first presented the model and its two dimensions; *relative power* and *degree of customization*. We explicitly stated that the goal of using this model was to elucidate attributes of the components sourced, other than what the Kraljic matrix did, and not to provide recommended strategies for each component. Having already mapped much of today's purchasing practice, the use of this model took substantially less time to test, as we already had insight in the components' characteristics and sourcing practice. In addition to the positioning

²⁹ PPA_ETO_Observation_X is used for PPA findings solely related to the ETO adapted model.

of the components, we challenged the purchasers in the first workshop to think about what would be an optimal way to approach their suppliers. They were selected for this challenge because we suspected that they had the best overview of how to improve, if necessary, the current situation. In addition, we believed that the purchasers would have the greatest benefit of such a discussion, as this coincides with their responsibility in the company.

Positioning the anchorage system

In the *first workshop*, we started the discussion by proposing that the degree of customization is high for the anchorage system, given that the anchorage system is individually engineered for each buoy's area of operation. Purchaser A responded that each buoy has its own customized anchorage system; however, the subcomponents are standard products that you can buy everywhere. We make the following observation:

PPA_ETO_Observation_1 Degree of customization is hard to measure; a component may be customized in the eyes of the customer, even though subcomponents are standard products.

We proceeded to ask about the suppliers, referring to the relative power dimension. According to Purchaser A, there are many suppliers, and “it is probably the buyer who has the power”. He then moderated his statement, and acknowledged that there are few suppliers who can deliver a complete system. However, he argued that in a worst case scenario, they can purchase the components and make the anchorage system themselves. We made a follow-up question by asking how important Fugro are for the current supplier. Purchaser A replied that “When I see how much we are buying for... They say that we are an important customer, and we have to believe their word”. Purchaser A continued by stating how much they purchase for from the respective supplier. Based on this, we proposed that the anchorage system may be positioned in the top-left quadrant; being a customized component where the buyer has a higher relative power over the supplier. The purchasers nodded in consent. We see that AR_Observation_3 applies, in that the participants replied confirmatory to this leading question.

As mentioned at the beginning of this subsection, we asked about what would be an optimal practice for the anchorage system. Purchaser A replied that they are continuously trying to locate several suppliers for each component, as they do not want to rely solely on one supplier; “it has been a focus of attention since we joined the MARGIN project. We are working on it all the time”. In the discussion of the anchorage system, we saw that PPA_Observation_2 applied; Purchaser B remained silent, as was also observed in the positioning of this component in the Kraljic matrix (7.3.1).

In the *second workshop*, SM1 immediately stated that the anchorage system is customized, whereupon E1 agreed. As this corresponded with our impression of the component, we were able to swiftly direct the discussion towards the relative power dimension. We asked about the relationship to the supplier that is currently used. According to E1, they are able to achieve lower prices on ropes, but not on the complete anchorage system. We made a follow-up

question by asking what the practice is today. E1 replied that they buy the entire system. SM1 then stated that “the anchorage system ends up in the middle of buyer and supplier dominated”. We wanted to challenge this somehow sudden positioning, and asked whether they are a large customer to the supplier. According to E1, they are not; the supplier is also supplying the much larger offshore and aquaculture industries. In trying to reveal how this affects Fugro, we asked if they are sometimes pushed back in line. SM1 answered that they probably are, based on some delay problems they have experienced. From this, we make the following observation:

ETO_Observation_13 Being a small customer may cause lower priority from the supplier (e.g., your orders may be pushed back in line due to larger orders from more important customers).

E1 added that even though they are a small customer, they have used them for 20 years; Purchaser A does, according to SM1, know them personally. E1 added that “if it is too bad, we can just make a phone call and straighten them up”. SM1 and E1 thereafter positioned the anchorage system as customized, in the middle of the relative power dimension. SM1 then made a concluding remark, in that “we are not important for the supplier, but we have a say. We are treated seriously when we come with small orders, because they know that we are capable of purchasing large quanta”. Hence, we make the following observation:

ETO_Observation_14 Long-term relationships may increase the priority from the supplier.

Positioning the inertial sensor

In the *first workshop*, we initiated the process by asking whether the inertial sensor is customized or standardized. Purchaser B answered that there is a low degree of customization; the inertial sensor itself is standardized. Next, we asked if they can easily change a supplier, and if it is many available suppliers to choose from. According to Purchaser B, there are few. He then moderated his answer slightly, and argued that there are some, but a change of supplier generates development work with respect to both hardware and software. This is in line with what he stated in the appliance of the Kraljic matrix (7.3.1). We then asked how important Fugro, as a buyer, are for the suppliers, keeping in mind ETO_Observation_13 above. Purchaser B reckoned that they probably are small. We followed up on this, by asking if this implies that Fugro cannot pressure the supplier to lower the prices. According to Purchaser B, this is possible if they buy large quanta. Purchaser A added that the suppliers are large, and supply products to the military industry, to which Fugro are small in relation. We asked if this would complicate the establishment of closer collaboration with the supplier, whereupon SM1 replied that it would be difficult. We make the following observation:

ETO_Observation_15 Being a small company, it is difficult to initiate close (resource intensive) relationships with large suppliers.

As for the anchorage system, we asked what would be an optimal approach towards the supplier; “would it be closer collaboration, or are things fine the way they are?” SM1 deviated from the question, and answered that the supplier is calling all the time, wanting to sell more.

PS_Observation_2 The purchasers tend to deviate when being challenged to consider practice other than what they are doing today.

The component was positioned in the lower-right quadrant; standardized product with supplier dominance. However, we saw that they in fact only positioned the circuit board of the inertial sensor, discarding the axiometers. From this, we make the following observation:

PPA_Observation_11 Complex product structures may cause sub-components to be forgotten in the positioning of the component, leading other sub-components to constitute the positioned component.

In the *second workshop*, SM1 initiated the process by explaining that the inertial sensor is designed and specified by Fugro, whereas its production is outsourced. E1 argued that “it is an off-the-shelf product for us”, and continued to explain that the components come from USA, whereas the production takes place locally in Norway. At this point, we were confused whether E1 was talking about the components for the inertial sensor’s circuit board or the axiometers, and we asked if he could explain briefly how the inertial sensor is assembled. E1 replied that the circuit board comes from the local supplier, whereas mounting of axiometers (from USA) and calibration take place at Fugro. Again we see that PPA_Observation_4 applies; complex product structures complicate the positioning process.

In order to position the component in the model, we asked whether the circuit board is customized or standardized. Both E1 and SM1 replied that the circuit board is customized in that they make a Fugro specific circuit board; however, their production process for circuit boards is standardized once the specifications are in place. According to SM1, “they make prints to order, that is what they do. They do not keep off-the-shelf products; when we send an order, they make the correct prints”. We make the following observation, in resemblance to PPA_ETO_Observation_1 made earlier:

PPA_ETO_Observation_2 Degree of customization is hard to measure; a component may be customized in terms of being specified to the customer, and still have a standardized production process.

We then made a comment about their extensive knowledge of this production, whereupon E1 replied that “we have used the supplier for 15-20 years”. Referring to relative power, we then asked if they can change supplier when they see it fit. According to E1, the supplier was chosen by tender. S1 added that “I think that when we have a supplier, we usually stick with him. We

usually end up with a new round of negotiations only when we have changed the product”. E1 stated that the relationship is not bound by contract, but the current supplier “is still kind of a main supplier”. SM1 then commented that the prices are relatively stable over a long period of time. We make the following observation:

ETO_Observation_16 The company rarely considers changing supplier; negotiations are initiated due to major changes in the product.

We saw the need to reach a conclusion about the positioning, and encouraged the participants to give it a try. In accordance with AR_Observation_1, the participants hesitated. As such, we utilized AR_Observation_4 (learning by the earlier stages in the process) in trying to overcome PPA_Observation_4 (complex product structures making the position difficult), and proposed that the axiometers are off-the-shelf products from large suppliers situated abroad, where the suppliers have power. Both E1 and SM1 agreed. We then proposed that the circuit board is customized, with Fugro having the larger relative power. Again, we saw that the participants answered confirmatory to leading questions, strengthening AR_Observation_3. Hence, the axiometers and the circuit board were positioned in the down-right and upper-left quadrants, respectively. In the next paragraph, the positioning of the data logger is described.

Positioning the data logger

In the *first workshop*, Purchaser B regarded the data logger to be standardized. He further stated that there are several available suppliers, and emphasized that “here, we *can* push down the prices”. Purchaser B, however, acknowledged that if a more important customer places an order, Fugro are pushed back in line. This is in line with ETO_Observation_13 (achieving less attention from the supplier due to being a small customer). Having ETO_Observation_14 (long term relationships may increase the attention from the supplier) in mind, we further asked whether the lead times increase if bigger customers than Fugro make an enquiry to the supplier. According to Purchaser B, that may happen; however, “they ask us how many units we *must* have. If we say that we must have a certain number of units, the supplier complies. They are flexible, even though we do not have a contractual relationship”.

Given our understanding of the data logger as a Fugro specific product, we asked if the components in it are standardized, whereas the data logger itself is customized. SM1 confirmed that the components in it are standardized. We followed up by asking that “if you look at what is delivered to you, is it customized? Tailored for your purpose?” SM1 answered “if you look at it in that way, yes. For us, it is standard, but it is made for us”. We make the following observation:

PPA_ETO_Observation_3 Degree of customization is hard to measure; a component may be standard in the eyes of the customer but customer specific in the eyes of the supplier.

We proceeded to ask if the purchasers could describe an optimal situation towards the supplier; “is it just to make a phone call, or is it more lucrative to establish a contractual agreement?” Purchaser B was not sure, and found it difficult to answer. He acknowledged that he may be continuing in the same old rut, but he appreciates keeping the options open. Purchaser B continued by stating that “I have worked here for some years, and I am on a first-name basis, so there have not been any problems so far. But you never know; I see the point that was made”. We finally proposed that the component could be positioned in the bottom-left quadrant of the matrix, whereupon both Purchaser A and Purchaser B agreed. We see that AR_Observation_3 applies, and make the following observation:

PS_Observation_3 The purchasers seem to be satisfied with the way things are, as there have not been any problems so far.

In the *second workshop*, it was not paid much attention to the data logger. It was merely mentioned at the end of the process of positioning the inertial sensor, as PPA_Observation_6 applied (the discussion derailed from the inertial sensor due to a complex product structure). However, both SM1 and E1 regarded the data logger to be Fugro specific. Further, E1 stated that “regarding the data logger, it is not possible to purchase it from one supplier today and another tomorrow”. Based on this brief evaluation, the second workshop positioned the data logger in the upper-right quadrant. In the next paragraph, the positioning of the shell is described.

Positioning the shell

In the *first workshop*, we first asked whether the shell is a customized product. Purchaser A answered that the supplier produces a product that belongs to Fugro; they are not selling the exact product to anybody else. We then wanted to investigate the relative power balance, asking if they are a small customer, or if they have bargaining power. Purchaser A responded that they have the power, in that several Fugro subsidiaries are using the same supplier, and a framework agreement therefore is put in place.

ETO_Observation_17 Buyer power is achieved through framework agreements, bundling volumes across subsidiaries.

Utilizing AR_Observation_4, we were further able to ask how this would be for the English supplier that was mentioned in the appliance of the Kraljic matrix (7.3.1). According to Purchaser A, they would probably come to an agreement, but not as good as the agreement with the current supplier; “the sum of the Fugro subsidiaries in Norway causes us to achieve a good agreement”. This did not alter the initial assessment of the component; consequently, it was positioned in the upper-left quadrant.

We thereafter wanted to know what would be optimal by asking whether they are satisfied with the current situation, or if they would prefer to have several suppliers. Purchaser A replied that they are currently gathering prices from the English supplier; “it will be interesting to see the

price”. Again, we see that they are not answering the question; as such, PS_Observation_2 applies.

In the *second workshop*, E1 initiated the positioning process by stating that “it is our product, no one else is allowed to purchase it”, referring to the degree of customization. We proceeded to ask if they could characterize the relationship with the current supplier. E1 replied that Fugro have used them in 15-20 years, and are satisfied with the supplier; “we have some minor problems with delivery time, but it has mostly been alright”. In order to further clarify the relative power, we then asked how it would be to change supplier. According to E1, a change of supplier would probably take from 3-4 months. In order to investigate whether ETO_Observation_16 applied (considering a change of supplier), we asked to which extent the current supplier’s price is competitive. E1 replied that they have never compared the price with any other suppliers; confirming our suspicion of ETO_Observation_16’s appliance.

When asked if they are a large customer to the supplier, E1 replied that they are one of the supplier’s largest customers. We then implied that this gives Fugro a say towards the supplier. E1 agreed; “they accept challenges, do not say ‘no’ and are willing to adapt to our requests”. SM1 added that “it is one of few suppliers where we are a relatively important customer. We represent a large share of their bottom line; we have purchased steadily over many years”. We make the following observation:

ETO_Observation_18 Large purchasing volumes over time increase the attention given by the supplier.

We then proposed that, based on the information at hand, the shell could be positioned in the top-left quadrant, whereupon the workshop participants agreed.

Positioning the battery pack

In the *first workshop*, we initiated the process by asking the workshop participants if the battery pack is standard or custom made for Fugro, referring to the component’s degree of customization. According to Purchaser A, they have acknowledged the benefits of standardizing the battery packs to a large extent. However, Purchaser A added that the battery pack consists of two very different components; lead batteries, which are readily available, and lithium batteries. Purchaser B added that the latter type is “special”. Purchaser A then concluded that the battery pack as a whole “is a mix of standard and ‘special’ products”.

In order to assess the relative power of the component, we asked the participants to specify the degree of influence on the supplier. Purchaser A replied that they have been able to achieve a relatively low price on the battery pack, because they know what it costs to produce such a battery cell. However, he added that they have chosen a cell that can only be manufactured by the currently used supplier. We see that PPA_Observation_11 applies, in that the participant is clearly referring to the lithium battery when evaluating the whole component, omitting the lead batteries. Purchaser A continued the evaluation of the relative power by stating that they achieve

bargaining power when they purchase larger quanta of batteries. We make the following observation:

ETO_Observation_19 Bargaining power is achieved by purchasing larger volumes.

Aiming for a conclusion, we proposed that the battery pack may be positioned somewhere between standardized and customized. The participants agreed, in accordance with AR_Observation_3. Purchaser A then added that because they have selected the specific type of lithium battery, it is hard to change supplier; referring to the relative power dimension. Consequently, the battery pack was also positioned in the middle of this dimension. In retrospect we realized that only the lithium battery was positioned in the matrix, and not the battery pack as whole, which was the intent. Hence, we again recognize the presence of PPA_Observation_11. As mentioned, we intended to challenge the participants, by asking them to evaluate what would be optimal towards the suppliers. This was not done for this component, as we saw that we were running out of time.

In the *second workshop*, as with the Kraljic matrix, we divided the battery pack in two components, utilizing AR_Observation_4 to mitigate the occurrence of PPA_Observation_4. E1 initiated the process of placing the components, by stating that the lead batteries are standard and the lithium batteries are custom made for Fugro. SM1 added that the lead batteries should be placed in the bottom-left quadrant. E1 then stated that the lithium batteries should be placed in the top-right quadrant. As such, the workshop participants were finished placing the components.

We wanted, however, to know more about their reasoning underlying these positions, as they did not explicitly refer to the relative power dimension. Hence, in order to challenge the previously made PPA_Observation_8 (an initial evaluation of the dimension alone may be altered when considering its underlying measures), we initiated a discussion about the relative power in the relationship with the supplier. E1 stated that they have little influence on the supplier of lithium batteries; “they decide – they do not reduce their component lead time, even when we propose to pay extra”. Further, he added that they have an alternative, more expensive, supplier. However, they try to plan the use of batteries, enabling them to make quarterly orders from their French main supplier. We agreed with this reasoning, and see that PPA_Observation_8 did not apply.

In an effort to make the participants further elaborate on the importance of power, we asked if the balance of power was considered when selecting a supplier. SM1 answered that this is not something one thinks about in the first place, “power is something you experience”. E1 added that price and lead time are important criteria for selecting suppliers, “it’s not like we want power”. We make the following observation:

ETO_Observation_20 Power is not considered ex ante; it is experienced ex post.

We further wanted to know to which extent company size was considered when selecting a supplier, further investigating the relative power in the buyer-supplier relationship. Hence, we asked if they preferred a smaller supplier over a bigger. SM1 answered that they previously used a smaller supplier of lithium batteries; however, they experienced problems with the quality of the component. Due to the consequences, they could not continue the relationship. SM1 added that they have never had problems with the larger French supplier, from which they now purchase lithium batteries. We make the following observation:

ETO_Observation_21 It is not necessarily best to use a smaller supplier; a bigger supplier may provide better quality products.

In the next paragraph we present the resulting positioning of the components in the ETO adapted model.

Resulting positions

Figure 42 illustrates the positioning of components in this model, for purchasing and marketing/sales and engineering, respectively. The symbols in the matrices correspond to the description in Table 46. Subscripts are included in the model to the right, to indicate the circuit board (CB), aximeters (Ax), lithium - and lead batteries.

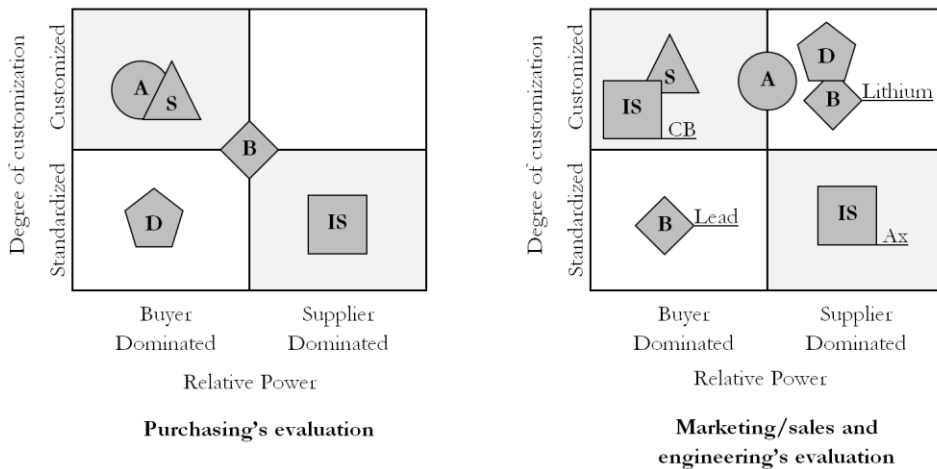


Figure 42: ETO adapted matrices with positioning of components

With respect to Figure 42, we see that the two workshops again have positioned the products rather differently. We are, however, not able to spot any trends in the positioning when comparing the two models. It may be observed that splitting of components results in a more nuanced picture. Especially the battery pack illustrates this; treating lithium – and lead batteries as two different components mitigates the danger of being ‘stuck in the middle’. In the first workshop’s evaluation, we see that all components, except for the data logger, end up in a diagonal line from top-left to bottom-right. This may imply that there is some kind of

correlation between degree of customization and relative power. However, as this is not reflected in the second workshop's evaluation, it cannot be said for certain. In the next subsection, the evaluation of applying the ETO adapter portfolio model is presented.

7.4.2 Evaluation of applying the ETO adapted portfolio model

As for Kraljic matrix, we evaluated the use of the model after the positioning was done. In this subsection, we first present the participants' evaluation of the process. Thereafter, our own evaluation of the process is presented.

The problem holders' evaluation

In the *first workshop*, we initiated the evaluation by asking whether there is value in considering degree of customization and the relative power balance, or if they keep this in mind when they purchase. Purchaser A replied that "it is at the back of our minds". Purchaser B added that they have been more conscious of these things after they joined the MARGIN project, and repeated what he said in the evaluation of the Kraljic matrix; "our auditor has pointed out stuff, like that we should have alternatives if a supplier succumbs".

We proceeded to ask how they perceived the positioning of the various components. Purchaser A felt that it was difficult because "you have a mix, it is not a single component but many components. Each module consists of different types of components. It makes it difficult to position". We see that PPA_Observation_4 applies. To challenge this, we asked if it would be beneficial with different strategies for e.g. the lead and lithium batteries, or if it is best considered as one single unit. The purchasers answered that when the battery pack consists only of lead batteries, it is fairly simple to handle. It seemed to us that they had forgotten their previous positioning of the battery pack in the strategic quadrant of the Kraljic matrix. In our opinion, treating a battery pack consisting exclusively of lead batteries as a strategic component would not be necessary, given the many suppliers and low profit impact of the lead batteries. Hence, we make the following observation:

PPA_Observation_12 The position of complex product structures may cause sub-components to achieve a disproportionate resource allocation in relation to its actual strategic importance.

In the *second workshop*, SM1 initiated the evaluation by regarding the ETO adapted model to be of more value than the Kraljic matrix. He argued that "this does not emphasize volume as much; one considers other aspects. I think this is more suitable for us". E1 regarded the positioning process to be easier, in that it was easier to relate to the components Fugro source. We proceeded to propose that the two models in a way are complementary, in that they consider different aspects of a component, whereupon the participants nodded their assents.

The researchers' evaluation

In the evaluation of the ETO adapted model, we discovered that some new information regarding the components and their sourcing practice emerged, as the participants were asked to evaluate new measures of the product. Hence, we make the following observation.

PPA_Observation_13 Additional measures and dimensions can make the practitioner consider more information when evaluating a sourced component.

Further, it was also apparent that the workshop participants needed to recapitulate many of the arguments they had used when they applied the Kraljic matrix. As such, it seemed that they had forgotten much of the previous discussion and conclusions derived from applying the first model. Finally, we realized that it was difficult for the participants to envision other situations than the one they were residing. In the next section, we turn to the last approach introduced to the participants.

7.5 Perception of the approach by Olsen and Ellram (1997)

Due to the extensiveness of the approach by Olsen and Ellram (1997), and lack of time, the components were not positioned in this approach. We did, however, introduce the model, and exemplify the use of it with the battery pack as an example. As such, we were able to give the participants an impression of how to use the approach.

In the *first workshop*, the participants agreed with the proposed strategy of “less contact and reduction of transaction cost” provided by the approach. Purchaser A added that he was unaccustomed to such investigation of relationships, and felt that this was an eye-opener. Because of limited time, we were not able to evaluate this model any further in this workshop.

In the *second workshop*, we had a little more time to evaluate the approach. The participants acknowledged that they could reduce their time used on the lead battery supplier, in accordance with the provided strategy. When asked if the workshop participants found this to be an attractive approach, SM1 stated that “the difference is that this one tells you what to do, the other models are more open”.

We wanted to further investigate the feasibility of the proposed strategy; hence, we asked if the workshop participants could envision the implementation of the generic strategy proposed by the purchasing approach. SM1 immediately stated that this would be difficult with their current supplier, and further explained that they regarded the relationship with the supplier as a “friendship”. As such, they do not wish to utilize their position over the supplier. Further, E1 added that they value quality higher than price; as such it would not be beneficial to use their buying power to achieve lower prices at the expense of quality. We make the following observation:

ETO_Observation_22 Long term relationships are difficult to terminate, as friendships evolve.

The discussion then somehow changed to concern the use of resources and time. SM1 stated that “if the relationship works and the component does not make out too much of the total cost of the product, we do not use time on changing suppliers. We use more time on more expensive

products”. We make the following observation, before proceeding to the total evaluation of the workshops:

PPA_Observation_14 Expensive products are considered more strategically important; if the relationship works and the products are inexpensive, time is not spent on changing suppliers.

7.6 Total evaluation

Each of the two workshops was finalized with a total evaluation. Here, we were interested in knowing what Fugro thought of the models; if there were any ambiguities; if they would be interested in implementing such models; value of the process versus the output; and so on (A.2). In addition, the first workshop was asked about the value of using the models in cross-functional teams (limited time did not allow this in the second workshop).

In the *first workshop*, we initiated the evaluation by asking which one of the three presented approaches they preferably would have used, if they were to choose one. Both Purchaser A and Purchaser B answered that they would have used the last one (by Olsen and Ellram, 1997). We found this rather surprising, and followed up by asking “even if it is more comprehensive?” Purchaser B responded that it was preferred because “it has more pigeonholes”. Hence, we make the following observation:

PPA_Observation_15 The approach by Olsen and Ellram (1997) was preferred over the Kraljic matrix and the ETO adapted model.

We proceeded by commenting that we had used the product as a basis for analysis in the Kraljic matrix. In this respect, we wanted to know if it was useful to also evaluate the relationship with the supplier, as was done in the approach by Olsen and Ellram (1997). Purchaser A replied that it was useful, and added that it was “a bit unaccustomed, but I think it was an eye-opener”.

Referring to the models in general, we further asked if the workshop had been valuable; if it was too comprehensive; or if it did not lead to a sufficient plan of action. Purchaser A stated that it was interesting to try it out, whereupon Purchaser B agreed. Purchaser B added that “I have to say, it fits with what we are experiencing”. When asked whether it would be relevant to adopt similar frameworks in Fugro, Purchaser A replied that “it is relevant to try it, yes”.

Keeping in mind that the purchasers preferred the approach by Olsen and Ellram (1997), we proceeded to ask which approach was the easiest to use, and why. Purchaser A answered that the approaches were very theoretical, but “model 3 gathered... it provided a bit more”. Purchaser B agreed. He further added that “we order much of the same things each time. Even if there are several available suppliers, we send the order to the same supplier each time, and ‘that’s it’”. We see that PS_Observation_3 applies, in that the purchasers seem to be satisfied with the way things are. In addition, we make the following observations:

PPA_Observation_16 The models were regarded as rather theoretical.

PPA_Observation_17 The approach by Olsen and Ellram (1997) was perceived as easier than the Kraljic matrix and the ETO adapted model.

With respect to PPA_Observation_16, we argued that we had used a lot of terms, like customization and risk, which are somewhat theoretical. We therefore wanted to know whether the use of the approaches was understood as exclusively theoretical, or if they were okay to combine with practical matters. Purchaser B claimed that they would have to develop it in practice; “but we have to start somewhere, and then we start with theory. We want to try it, it would be interesting”. We followed up by asking whether the dimensions were easy to relate to. Purchaser B thought that it was fairly easy, arguing that risk and profit are understandable terms; “very symbolic, easily understandable”. We see that PPA_Observation_1 applies, in that Purchaser B disregarded the underlying measures of the dimensions. We proceeded by asking the participants what they perceived as most difficult with the approaches; “was it too much information to consider at once? Perhaps it is not that difficult?” Purchaser B answered that he did not think it was that difficult.

Next, we asked whether the purchasers thought that it would be valuable to include several business functions in the process, to get different perspectives on products and component, or if everyone has the same information. Purchaser B first replied “well, what can we say?”, and made a follow-up by explaining that the salespeople know the products, but ask purchasing and engineering if customers’ enquiries are too complex. Purchaser A added that the participants in the second workshop are familiar with the products: “[SM1] has worked with engineering, but has started to work with sales. [E1] is mostly working with engineering, but is also involved in making tenders. Both are involved with several processes, they are not pure salesmen. They know what they are selling”. This confirms ETO_Observation_7, in that an employee may possess extensive knowledge of several functions.

Finally, we asked what is regarded most beneficial; the discussion or the output with respect to strategies. Purchaser A thought that they are currently doing much of what was recommended in the strategies, and felt that the process was valuable; “you learn something all the time, I found that useful”.

In the *second workshop*, we initiated the evaluation by asking if the approaches’ ways of looking at components were useful, and if they elucidated aspects that are not usually in focus. E1 replied that it was interesting. SM1, however, stated that “I am often left with the impression that we nod in recognition; however, implementation has turned out not to be straightforward. We can go from meetings with a lot of good points, but have no action plan afterwards”. E1 added that “knowledge is one thing, implementation is another. But it is always nice to acquire knowledge”.

SM1 argued that if they are to implement a system, someone has to be in charge of it; “resources must be set aside for it, and we are not so good at that”. We make the following observation:

PPA_Observation_18 Personnel should be dedicated to carry the responsibility of implementing the use of a purchasing portfolio approach.

As in the first workshop, we wanted to know whether the use of the approaches was understood as exclusively theoretical, or if it would be okay to combine it with practical matters. SM1 felt that it was too theoretical, and that it was a combination of several things; “you cannot say that *that* was the solution for us”. Based on this, we wanted to know if an approach would have to be tailored for their purpose. SM1 agreed, and continued by arguing that “this was new models once again; new names and new terms”. E1 added that evaluation is important, in terms of what category components are. According to him, this has not been done because time has not been set aside for this purpose. SM1 then built on his previous statement, by arguing that none of them are skilled enough to see that “Wow, we can implement that one!” Hence, we make the following observation:

PPA_Observation_19 Limited time and resources impede the implementation of a purchasing portfolio approach.

Further, we asked if terms and the dimensions are fairly okay to relate to, or if it immediately is too theoretical. SM1 replied that “‘leverage’ does not say much, things like that are taken into consideration”. We see that PPA_Observation_5 applies, in that SM1 gets caught up in the names of the quadrants. E1 added that it is difficult when a component consists of various subcomponents; “you can evaluate a screw in no time, but when you purchase complex things like we do, it is difficult. We may depend on three or four suppliers for just one component”. Again, we see that PPA_Observation_4 applies (complex product structures making the positioning difficult).

SM1 then again picked up the challenge of implementation, arguing that “we do not work as the big contractors; we do not have a group dedicated for such work. We do have routines, but we do not set aside people for such work. It is a political decision in the company; ‘is this something we should do? Does it provide value? Are we so small and niche that there is no point?’. If we choose to do it, we have to set aside people that make routines based on the analysis”. Hence, we make the following observation:

PPA_Observation_20 The implementation of a purchasing portfolio approach is a political decision, in that top management must allocate time and resources for this purpose.

Finally, we asked the participants what was most valuable; the discussion around components or the action plans such approaches provide. Both SM1 and E1 argued that the evaluation process was most valuable; SM1 finally stated that “I do not find the result evident”. We make the following final observation, before proceeding to some reflections on the process as a whole:

PPA_Observation_21 The process was perceived more valuable than the output, the latter in terms of generic strategies.

Researchers' evaluation

We here evaluate the action research in light of problem solving and research interests, coinciding with the dual imperative approach to action research (2.3.3).

With respect to *research interest*, we feel that the action research has been highly valuable. Through having an active and facilitating role in the workshops, we have gained insight in the main topics of this master's thesis, beyond what could have been achieved through passive observation. In our opinion, the purchasing portfolio approaches functioned as valuable frameworks to discuss purchasing practice and bring forth tacit knowledge by facilitating communication. We emphasize this by making the following observation:

PPA_Observation_22 Through discussion and mutual reflection, tacit knowledge may be codified, practice formalized and communication facilitated by the use of a purchasing portfolio approach.

By challenging the workshop participants to position components in a sample of purchasing portfolio approaches, we further experienced challenges associated with their use. As such, we have been able to map the micro perspective of purchasing portfolio approach usage, hence complementing the (macro perspective) survey research (chapter 6) in a neat manner.

Further, we have been able to observe and map purchasing practice in an ETO company. The practice has its challenges with respect to robustness, as contractual agreements are rarely used. We have seen various reasons for the lack of contractual agreements; these reasons may restrict the feasibility of purchasing portfolio approaches' recommended strategies. Further, we have seen how various product types may not be straightforward to position in a purchasing portfolio approach, due to uncertainty related to the products' structure and varying characteristics. By conducting two workshops, with employees from different functions, we have further been able to observe the need for cross-functional integration in an ETO company.

We feel that the workshops were conducted in a good way; however, we acknowledge that limited time hindered us from carrying out all of the planned aspects. Nevertheless, we were able to make valuable observations throughout the whole process, including the aspects that were granted limited time. In retrospect, we see we have few explicit observations concerning purchasing sophistication. We do, however, feel that we are able to assess purchasing

sophistication by utilizing the remaining observations when investigating the linkages between the topics in the theoretical framework; this is done in the later analysis.

With respect to *problem solving*, we are convinced that the process has been valuable for the problem holder (Fugro). We acknowledge that we in no way have implemented the use of purchasing portfolio approaches in the company; however, we argue that the process has provided ideas, perspectives and theoretical input that will help them in achieving a more proactive approach to purchasing. This is supported by statements made in the workshops; Fugro stated that they have to start with theory in order to implement tools. Further, the provided perspectives, especially with respect to a more conscious approach towards suppliers, were said to be an eye-opener. We argue that more time is needed in order to solve Fugro's 'problem' of reactive sourcing. As mentioned in the methodology (2.3.4), we were not able to complete the action research cycle. The authors' contribution to the case company has therefore been to introduce a tool for pro-active and systematic sourcing, purchasing portfolio approaches. Finally, we want to add that the findings will be presented for the company at a later point in time, further providing value for the problem holder.

7.7 Conclusion

In this chapter we have provided the empirical findings from our action research, making explicit observations from both workshops. These observations are classified according to the topics in the ternary relationship of purchasing portfolio approaches, purchasing sophistication and engineer-to-order. The observations are summarized in appendix A.5, and will be further used in Part III for subsequent analyses. We feel that the action research has been valuable, from both the researchers' and the problem holder's point of view.

This concludes Part II, Empirical investigations. As such, we proceed to Part III, where our analysis and discussion are presented.

Part III: Analysis and discussion

In this part, we present our analysis and discussion. First, the theoretical framework that was developed in Part I is refined in chapter 8, by utilizing findings from the survey- and action research (Part II). Here, each of the topics constituting the ternary relationship is treated; starting with purchasing portfolio approaches, proceeding to purchasing sophistication and ending with engineer-to-order. As described in the methodology (2.1.3), this refined framework provides our final answer to RQ1.

In the three subsequent chapters, the linkages between these above mentioned topics are investigated, by using empirical data and the refined framework from chapter 8. In chapter 9, the linkage between purchasing portfolio approaches and purchasing sophistication is investigated, with the goal of answering RQ2. This is followed by an investigation of the linkage between purchasing sophistication and engineer-to-order in chapter 10; answering RQ3. The last linkage, constituting purchasing portfolio approaches and engineer-to-order, is investigated in chapter 11. Here, our last research question, RQ4, is answered. Figure 43 illustrates the structure of this part. The observations made in the action research (chapter 7) will be explicitly stated, and we again remind the reader of appendix A.5 for a complete overview of these observations.

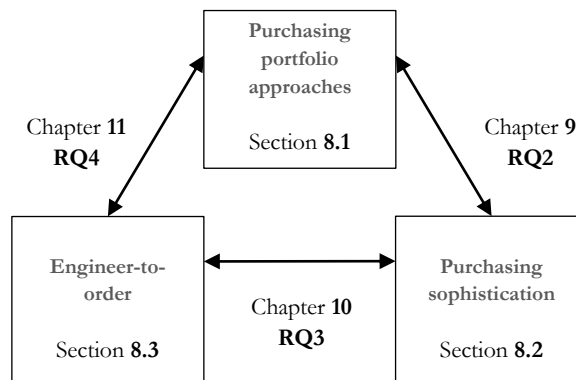


Figure 43: Structure of the analysis

8 Refining the theoretical framework

The purpose of this chapter is to refine the theoretical framework developed in Part I (Figure 31), with knowledge acquired through our empirical investigations (Part II). The first section (8.1) presents a discussion of purchasing portfolio approaches. Here, survey – and action research findings are discussed in relation to theory on subjects identified as relevant for the topic. This is then repeated for purchasing sophistication (8.2) and ETO (8.3), respectively. We conclude this chapter with a refined framework (8.4), answering the first research question (c.f. 2.1.3). This framework will further be utilized in the remaining chapters of this analysis, in addressing the linkages in the ternary relationship, as described in Figure 43.

8.1 Purchasing portfolio approaches

In this section, we first present analysis of the survey research findings, including an empirical validation of the *context of purchasing portfolio approaches*. Further, we wish to expand the framework by including a macro perspective; illustrating the prevalence of purchasing portfolio analysis in Norwegian production companies, and how the use of purchasing portfolio analysis relates to relevant variables (6.1) of a company. This is followed by a discussion of action research findings in relation to theory on *main purposes*; *comparison between approaches*; and, *critique*. Further, we wish to expand the framework by including operational challenges that were discovered during our action research. Finally, we present the refined framework with regards to purchasing portfolio approaches. This will be brought along to the conclusion at the end of this chapter.

8.1.1 Survey research findings

In this subsection, we first present our empirical validation of the context of using a purchasing portfolio approach, by investigating its relation to having a sourcing strategy (6.1.2). Thereafter, we include a macro perspective of using a purchasing portfolio approach, presenting findings on *how many* and *what types of companies* that are using purchasing portfolio approaches. Finally, a comparison of the use a purchasing portfolio analysis with remaining relevant variables (6.1; having a purchasing department; company size; and, purchasing-to-turnover ratio) is given.

Context of using a purchasing portfolio approach

According to Monczka et al. (2011), a purchasing portfolio approach provides a recommended sourcing strategy for each of a company's sourced products (3.1.1). In analyzing the empirical evidence from the survey research, we discovered a significant relationship between having a sourcing strategy and the use of purchasing portfolio approaches (6.3.3). In order to establish the direction of the relationship, we have to ask ourselves two questions; how can having a sourcing strategy lead to the use of purchasing portfolio approaches, and vice versa? It may be that a company possessing a sourcing strategy would use purchasing portfolio approaches in order to validate, refine or expand the existing sourcing strategies. However, such use would require the company to position their products in the approach, in order to derive sourcing strategies. As such, they have in fact used purchasing portfolio approaches to establish sourcing strategies, which is in accordance with the described context for which to use a purchasing portfolio approach. Consequently, we argue that the use of purchasing portfolio approaches leads to having a sourcing strategy, and not the other way around.

Use of purchasing portfolio approaches – A macro perspective

Theory on purchasing portfolio approaches is vast; however, we have identified no mapping of the actual use of such approaches in Norwegian companies; that is, *how many* and *what types of companies* are using them. Our survey research, however, enables us address this. Table 48 shows the spread of purchasing portfolio analysis usage related to the different production situations, as well as the total percentage of users and non-users.

THE USE OF PURCHASING PORTFOLIO APPROACHES ACCORDING TO PRODUCTION SITUATION			
Production Situation	Use purchasing portfolio analysis		Total sample
	Yes	No	
MTS	55.6%	44.4%	9
ATO	70.0%	30.0%	10
MTO	56.5%	43.5%	23
ETO	48.8%	51.2%	41
Non-Production	34.5%	65.5%	55
Total	47.1%	52.9%	

Table 48: The use of purchasing portfolio approaches in relation to production situation

Table 48 shows that as much as 47.1 % of the responding companies stated that they use purchasing portfolio approaches. Comparing the different production situations, it is apparent that assemble-to-order (ATO) companies have the highest percentage of purchasing portfolio analysis users, whereas non-production companies have the lowest. It is, however, important to note that the sample size of the ATO group is small, implying that the result not necessarily is representative for the Norwegian ATO companies. Nonetheless, the high use of purchasing portfolio approaches in ATO companies warrant further research, as the reason for this finding is unknown. On the other hand, non-production companies have the highest sample size, strengthening the external validity of this result. We suggest that non-production companies are likely to purchase lower volumes at a lower frequency; which may be a reason for the low percentage of non-production users.

The survey research revealed that 52.9% of the respondents did not use purchasing portfolio analysis. Of these, the majority claimed that they did not see the need for such an analysis; that they employed their own method for categorizing sourced products and services; or that they did not have sufficient resources (6.3; Figure 35). The latter is in contrast to an identified purpose of purchasing portfolio approach; helping to optimize a company's limited resources (3.3.1). Further, Figure 35 (6.3.1) reveals that nearly all companies that have tried to use a purchasing portfolio approach, have continued to use it. We argue that this finding is an indication of purchasing portfolio analysis being perceived as valuable once it has been used.

Finally, we discovered that very few companies have never heard of purchasing portfolio approaches at all (Figure 35). This indicates a high degree of recognition; the majority of the responding companies are familiar with the concept of purchasing portfolio approaches.

Purchasing portfolio analysis in relation to other relevant variables

When analyzing the survey data with respect to the use of purchasing portfolio analysis (6.3), the significant relationships in Figure 36 were established. In summary, we discovered that the use of purchasing portfolio approaches is more prevalent in large companies, and in companies having a purchasing department. Further, we found a significant relationship between purchasing-to-turnover ratio and having a sourcing strategy. We will now discuss each of these relationships, and imply a direction of them, as we cannot infer causality through the survey research (2.4.5).

PPA and purchasing department

The survey data indicated that a slight minority of the companies (47.6%) had a dedicated purchasing department (6.3.2). This is a considerably higher percentage than discovered by Quayle (2002) in his exploratory survey research of SMEs (6.1.1). However, our total sample includes, in addition to small and medium-sized companies, also large companies. A study by Boyer et al. (1996) identified that smaller firms have fewer resources than larger firms (6.1.3). Hence, we argue that some of the difference in having a purchasing department is due to larger companies having more resources, which in turn is likely to allow a higher degree of specialization. With a higher degree of specialization, we argue that the company is more likely to have a dedicated purchasing department. Our percentage of SMEs with a dedicated purchasing department is considerably smaller than the overall sample average; only 32%. However, this is still higher than what Quayle (2002) discovered (6.1.1). We argue that this may be a reflection of the increased strategic recognition of purchasing over the last ten years (1.1.4).

Further, the survey research revealed a significant relationship between using a purchasing portfolio approach and having a purchasing department (6.3.2). We argue that this finding may be explained by the fact that a purchasing department will have the necessary time and resources available for conducting purchasing portfolio analysis. In a company where purchasing does not have a dedicated purchasing department, it may be harder to justify the use of a purchasing portfolio approach, as these resources could be argued to provide more value when used on other activities. As such, we argue that having a purchasing department may lead to the use of purchasing portfolio approaches, and not the other way around; indicating a direction of the relationship.

PPA and company size

We discovered a significant relationship between the use of purchasing portfolio analysis and company size; indicating that larger companies are more likely to use a purchasing portfolio approach compared to smaller companies. As mentioned in the previous paragraph, we found from theory that larger companies have more resources. Gelderman and van Weele (2005) argue that large companies are more likely to be situated in a complex sourcing situation that requires advanced analytical tools (6.1.3). Syson (1992, referred to in Trautmann et al., 2009) argues that

the ability of a purchasing portfolio approach to break down complex problems into their most important dimensions is an appreciated characteristic of purchasing portfolio approaches (3.3.1). Based on this, it was not surprising that we discovered a significant relationship between large companies and the use of purchasing portfolio approaches. In relation to the direction of the relationship between the variables, we reckon that the use of purchasing portfolio approaches is not likely to make a company grow in number of employees. As such, we argue that it is being a big company that affects the use of purchasing portfolio approaches, and not the other way around.

PPA and purchasing-to-turnover ratio

The purchasing-to-turnover ratio was employed as an indicator of the importance of purchasing in a company (6.1.4). Several authors (Wind and Mahajan, 1981; Turnbull, 1990; Pagell et al., 2010) argue that an application of purchasing portfolio approaches is to ensure optimal use of a company's limited resources in relation to different supplier relationships (3.3.1). As such, it would also be natural that a high purchasing-to-turnover ratio would trigger the use of purchasing portfolio approaches, to optimize the use of the high purchasing expenditure. However, when investigating this variable in relation to the use of purchasing portfolio analysis, we discovered that the relationship was not significant (Figure 36), indicating that this is not the case. On the other hand, we discovered a significant relationship between the purchasing-to-turnover variable and having a sourcing strategy. It indicated that companies with a large purchasing-to-turnover ratio are more likely to have a sourcing strategy (6.3.5). In relation to the direction of this relationship, we acknowledge that having a sourcing strategy may reduce the purchasing-to-turnover ratio to some extent, through having a more careful sourcing practice. However, we regard it more likely that it is the purchasing-to-turnover ratio that initiates the use of a sourcing strategy, and not vice versa.

When further investigating the ratio's relationship to the variables of purchasing department and company size, we found no significant result (Figure 36). These findings are interesting, as we suspected that a company with a high purchasing-to-turnover ratio at least would have a purchasing department, due to the indicated importance of purchasing. As such, it is likely that other factors affect the establishment of a purchasing department in a higher degree than the purchasing-to-turnover ratio. As an example, a smaller company with a high purchasing-to-turnover ratio may not have enough resources to allow the establishment of a purchasing department, in line with the discussion above (PPA and company size).

Proposed directions of significant relationships

In the previous paragraph, we discussed possible directions of the identified significant relationships with respect to the use of purchasing portfolio analysis. Figure 44 illustrates the directions that were proposed.

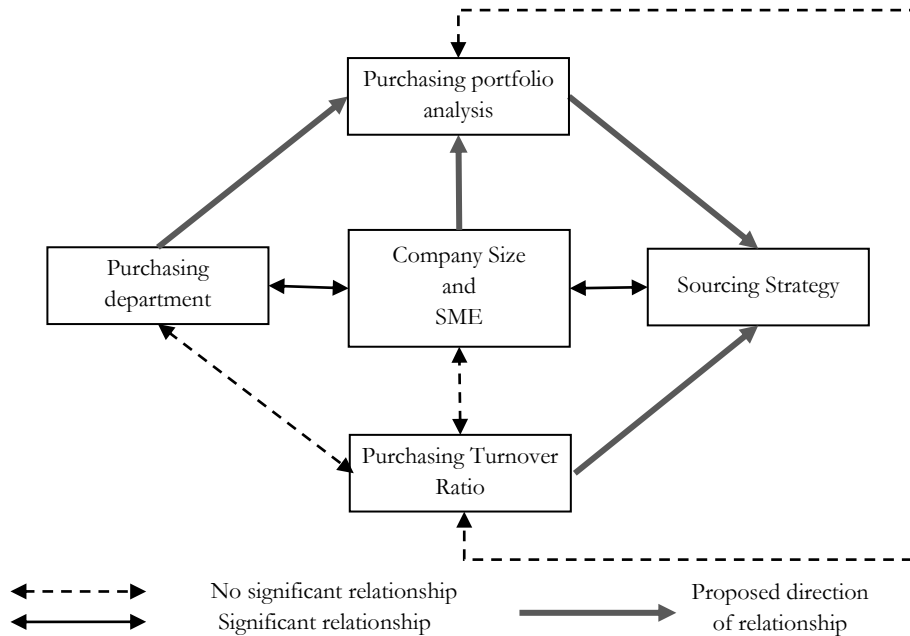


Figure 44: Proposed relationship between using purchasing portfolio analysis and other variables

Next, we present our action research findings in relation to the topic of purchasing portfolio approaches.

8.1.2 Action research findings

In this subsection, we present and discuss action research findings related to purchasing portfolio approaches. First, *main purposes* of using purchasing portfolio approaches are discussed. Second, we refine the *comparison between purchasing portfolio approaches* (limited to their number of stages) by adding empirical experiences. Third, we discuss *critique* of purchasing portfolio approaches, with respect to the positioning of products and the models' dimensions. Finally, we discuss important observations made in the action research that were not identified in theory. These findings further contribute to refining the theoretical framework at the end of this section.

Purpose

In this paragraph, we first reflect on two of the identified main purposes of using PPA; organizing information and facilitating communication. With respect to the latter, we show how purchasing portfolio models may function as codifiers of tacit knowledge; refining a purpose previously identified in literature.

Organizing information

In the development of the theoretical framework, we found that purposes of using purchasing portfolio approaches could be divided in three main groups (3.7). The second group, termed

‘organizing information’, included arguments provided by Olsen and Ellram (1997) and Syson (1992, referred to in Trautmann et al., 2009). These authors explain that a purchasing portfolio approach may be used as an analytical tool to organize information, by breaking down complex problems.

We found this purpose evident in the action research in several forms. First, when placing the anchorage system in the Kraljic matrix, one of the participants ended up discarding his initial thoughts and classification when evaluating measures of the dimensions that were not considered initially (PPA_Observation_3). A similar observation was made when the shell was positioned in the same matrix; here an evaluation of the dimension alone was substantially altered as the underlying measures were considered (PPA_Observation_8). These observations support the suggestion made by Olsen and Ellram (1997), in that more correct classifications can be made when evaluating every measure of dimension systematically, in this way organizing information. Further, we discovered that additional information on the products came to light when the workshop participants were set to evaluate additional measures and new dimensions of a component (PPA_Observation_13). Hence, one can argue that it is beneficial to add more measures for each dimension, and perhaps evaluate additional dimensions to the purchasing portfolio model. We argue that even two different approaches may be used. However, we would like to emphasize that this has to be within the limits of the two appreciated characteristics of purchasing portfolio approaches, provided by Dubois and Pedersen (2002) (3.3.1); the approach still has to be easily understood and communicated, and it should still provide practical guidelines.

Olsen and Ellram (1997) argue that the process of categorizing the sourced products in purchasing portfolio approaches may be even more valuable than the classification itself (3.5.3). This was also found when conducting action research: When evaluating the use of the purchasing portfolio approaches, the process of using the approaches was regarded as more valuable than the actual output from the approaches (PPA_Observation_21). It was actually stated that the end results from the classifications were “not evident” (7.6). From this, we argue that when employing any purchasing portfolio approach, the classification should be done in a manner which maintains the procedural benefits. Consequently, we suggest that the operationalization of an approach should facilitate discussion, with participants from several functions within the company (in accordance with PPA_Observation_7). From this, we further argue that classification by utilizing spreadsheets – assigning numerical values to the different measures and hence calculating the position in the model, may be counterproductive. The underlying measures of a dimension should help facilitate the discussion, rather than being given a value and then be set aside.

Facilitating communication

A third identified purpose of using purchasing portfolio approaches is the facilitation of communication (3.7). Gelderman and van Weele (2005) argue that a purchasing portfolio approach can be “an effective tool for discussing, visualizing and illustrating the possibilities for differentiated purchasing and supplier strategies” (p.35). In addition, Smart and Dudas (2007) find that it may facilitate communication, and that its simplicity makes it easy to communicate to

other members in the organization. Finally, Olsen and Ellram (1997) state that the use of a purchasing portfolio approach forces the users to discuss inconsistencies, and agree on the importance of different products, supplier or relationships to be classified in the approach (3.5.3).

In our evaluation of the workshops, we made an observation which supports these identified purposes of using a purchasing portfolio approach, stating that “through discussion and mutual reflection, tacit knowledge may be codified, practice formalized and communication facilitated by the use of a purchasing portfolio approach” (PPA_Observation_22). We argue that *communication is facilitated* through having the users of a purchasing portfolio approach discuss and evaluate several measures and dimensions for each purchasing portfolio model. Hence, we have learned *how* purchasing portfolio approaches may facilitate communication, not just that it *can*. Further, *tacit knowledge may be codified* and made explicit through having users of purchasing portfolio approaches explain their reasoning when addressing the different measures and dimensions. In relation to this, valuable insight of the product, supplier or the relationship in question can be gained from gathering personnel from different functions to participate in this process (PPA_Observation_7). We argue that the simplicity of a portfolio model makes it feasible for being used by non-purchasing professionals. Finally, *formalization of practice* may be attended to through having the workshop participants exchange their experience, as a means to become aware of the actual sourcing practice, and possibly identify an internal best practice. Comparing these findings in relation to theory, we have refined purchasing portfolio approaches’ purpose of facilitating communication, by taking into account their potential to codify tacit knowledge and formalize practice.

Comparison of purchasing portfolio approaches

In the specialization project conducted fall 2011 (1.1.6), we proposed that purchasing portfolio approaches have a varying degree of comprehensiveness, and suggested that a comprehensive tool would be more difficult to use. However, through action research, we found that purchasing portfolio approaches’ comprehensiveness not necessarily reflects their difficulty of use.

In the total evaluation of the applied and introduced purchasing portfolio approaches in the workshops (7.6), it was stated that the approach by Olsen and Ellram (1997) was preferred over the Kraljic matrix, as it had more “pigeonholes” (PPA_Observation_15). In addition, it was perceived as easier (PPA_Observation_17). This contradicts with our preconceptions from our specialization project (1.1.6), where the approach by Olsen and Ellram (1997) was assumed to be the most comprehensive of the approaches tested, hence being harder to use. In trying to explain this contradiction, we argue that this may be due to the approach by Olsen and Ellram (1997) providing a rather elaborate description of how it is to be employed; i.e. providing incomplete but extensive lists of measures to evaluate each dimension in both portfolio models employed (3.4.2). Hence, it may seem that a comprehensive approach may be easier to use, as its guidelines may be more elaborate. As such, the approach is more specified, and thus less complex, because complexity is divided up into subcategories and underlying measures.

However, it should be noted that the workshops only were introduced to the approach by Olsen and Ellram (1997), due to insufficient time. As such, they were not able to apply it themselves, but expressed their impressions on the basis of the researchers' demonstration. Nonetheless, we feel that the finding regarding the comprehensiveness of approaches still holds. In summary, we recognize that the degree of comprehensiveness of a purchasing portfolio approach is not necessarily an indicator of its difficulty of use. Further, we argue that this observation applies both ways; a less comprehensive approach may be harder to use, as it provides less guidance for use.

Critique

In this paragraph, we reflect on the critique related to the positioning of products in purchasing portfolio approaches and their dimensions (3.5). First, we discuss the critique of viewing products as 'given' objects, before elaborating on the perceived ambiguity of the models' dimensions.

Viewing products as 'given' objects

In the identified critique of purchasing portfolio approaches (Table 17), Dubois and Pedersen (2002) argue that objects are viewed as 'given' when analyzed by the use of PPA; neglecting aspects such as developing, producing and using the products. In our action research, we found evidence that supports this critique. In the positioning of the anchorage system that Fugro source, we learned that the anchorage system module is engineered for every buoy, and hence different for every product. More specifically, the types of components used are the same for each product, but some characteristics of the components (e.g. length of ropes) are different. This leads to price variations from module to module, and hence a different position in the Kraljic matrix with regards to profit impact. For instance, if the buoy is to be placed in shallow waters, shorter ropes are needed – leading to low price and low profit impact. However, when the buoy is placed in deep waters, up to 5000 meters, more rope must be purchased – leading to high cost and, hence high profit impact (7.3.1; ETO_Observation_2). We see that the component is not constant; rather, it is varying in terms of specifications. This varying property of a component makes it hard to position it in a purchasing portfolio model. As such, we acknowledge the critique by Dubois and Pedersen (2002) in that objects are 'given' in a portfolio analysis; which neglects aspects of, among others, production. We have through our action research illustrated how viewing products as 'given' may be problematic in positioning components.

Scenarios may also be imagined where a module in the product is engineered for each product, and the engineering leads to a need for different components in the module. As such, the module may also differ in terms of variety; not only quantity (and as such, cost), as exemplified above. Hypothetically, these components may vary in terms of both profit impact and supply risk, using the Kraljic matrix as an example. A module can hence vary in two dimensions – making it even harder to utilize a purchasing portfolio approach that is to give you *one* strategy for a component. As such, we argue that purchasing portfolio approaches may be inappropriate when sourcing components that are engineered for each product.

Ambiguity of the dimensions

A major part of the critique of purchasing portfolio approaches relates to the dimensions of purchasing portfolio models (Table 17). However, in the action research, we made an observation concerning the dimensions of the tested portfolio models that was not identified in theory (PPA_Observation_1). The observation concerns the difficulty of how to interpret the dimensions: Should one only evaluate the underlying measures of the model's dimension, or can the dimension itself be utilized as a measure? Findings from our action research indicate that the dimension itself often was perceived as a measure, and the participants often evaluated the dimension in a similar manner as the underlying measures. We argue that this ambiguity of the dimensions may be circumvented by explicitly explaining the difference between a dimension and its measures. Hence, we believe that this observation does not contribute to undermine the utility of purchasing portfolio approaches.

Operational challenges

In this paragraph, we illustrate challenges that arose during the action research, concerning the quadrants of purchasing portfolio models and the positioning of modules. We argue that these findings fall outside of the topics included in the theoretical framework (Figure 31). As such, the findings discussed in this paragraph will be included in the refined framework under the banner 'operational challenges', because they relate to the implementation of purchasing portfolio approaches.

Predispositions caused by the quadrants' names

Somewhat unexpected, we discovered that the names of the quadrants in a purchasing portfolio model may cause predispositions with respect to the positioning of components (PPA_Observation_5). This observation was made after one participant in the second workshop stated that he was not comfortable the 'leverage' quadrant of the Kraljic matrix. This led, perhaps unintentionally, to the second workshop not placing any components in the leverage quadrant (7.3.1).

This problem is not identified in theory. We argue that a simple remedy may be to remove the names of the quadrants when using the portfolio model. As such, we argue that this observation does not undermine the utility of purchasing portfolio approaches. This motivates why it is not considered as critique, but rather as an operational challenge. In addition, only one participant had such a predisposition; as such, the external validity of this identified problem is quite weak.

Difficulty in positioning modular components

In the action research, we discovered that the modular characteristic of several of the tested components complicated the use of the approaches (PPA_Observation_4; PPA_Observation_6). When placing the inertial sensor in the ETO adapted model, we discovered that a complex product structure may cause sub-components to be forgotten or not evaluated in the positioning process at all (PPA_Observation_11). Further, when the participants were made to evaluate the ETO adapted model, we discovered a consequence of the previous observation; namely that some sub-components may achieve a disproportionate amount of resources in relation to their strategic importance (PPA_Observation_12). This

observation is in direct contrast to one of the main purposes of using a portfolio approach; namely to help a company optimize its use of limited resources (3.3.1). As such, we argue that components should be evaluated at a disaggregated level to the extent possible.

One exception is when the company conducts *systems sourcing*; i.e., that a module is sourced from a sole supplier, as was the case for the anchorage system. In the action research, we saw that the workshop participants knew each subcomponent comprising this sourced component very well, because they used to make it themselves prior to outsourcing the production to a local supplier (7.3.1). The purchasers in the first workshop considered the anchorage system's standardized components when positioning the anchorage system, arguing that the supply risk was low. The second workshop took, however, the supplier's work practices into account, and argued that this limited the number of available suppliers. We therefore argue that a sourced system should not be disaggregated prior to its positioning in a purchasing portfolio approach, because the underlying components may distort the perceptions of the module, leading to a less favorable positioning.

Using an external facilitator

There may be both pros and cons of having an external facilitator when conducting purchasing portfolio analysis. When conducting action research, we found that the participants of the workshops tended to hesitate, and await guidance from the researchers (AR_Observation_1). The researchers' presence may have resulted in that the participants became passive. Further, we found that the researchers have great influence on the problem holders, who tended to reply confirmatory to leading questions (AR_Observation_3). As such, the researchers' presence may have been responsible for some of the choices made by the participants. However, we also found that the participants tended to deviate from the positioning process, and discuss other aspects than the positioning of the component (AR_Observation_2). As such, we believe that the presence of a facilitator is needed to some extent, in order to keep the discussion on track.

8.1.3 Towards a refined framework – Purchasing portfolio approaches

We have in this section presented analysis of the findings related to purchasing portfolio analysis from both survey research and action research. First, we presented analysis of the survey research findings, including a discussion of empirical data that validated the *context of purchasing portfolio approaches*. Further, we took a macro perspective; illustrating the prevalence of purchasing portfolio analysis in Norwegian production companies, and how the use of purchasing portfolio analysis relates to relevant variables (6.1) of a company. This has not been done previously, and we therefore include these findings in the refined framework.

Second, the action research analysis evaluated empirical findings in relation to theory. With respect to *main purposes*, we validated the purposes of organizing information and facilitating communication. With respect to the latter, we identified an additional intention of use; the use of purchasing portfolio approaches to codify tacit knowledge and formalize practice. This is included in the refined framework. Further, in a *comparison between approaches*, we used the approaches' number of stages to discuss whether a more extensive approach is more difficult to use. This indicated that a more elaborate approach may in fact make it easier to use, as it breaks

down the complexity into manageable pieces. We then proceeded, by addressing *critique* with respect to the positioning of products and the models' dimensions. We here supported the critique of viewing products as 'given', and added some considerations of the perceived ambiguity of a purchasing portfolio model's dimensions. Finally, we added findings in relation to operational challenges. These are brought along to the refined framework.

From this, we update the theoretical framework developed in Part I (Figure 31) with our findings from the empirical investigation. We have here included both validations of identified theory (✓), where this is possible, and additions (+) to the framework. In the final section of this chapter (8.4), the refined framework is presented. The findings that are to be brought along to the final refined framework, in addition to validations of theory, are illustrated in Figure 45 below.

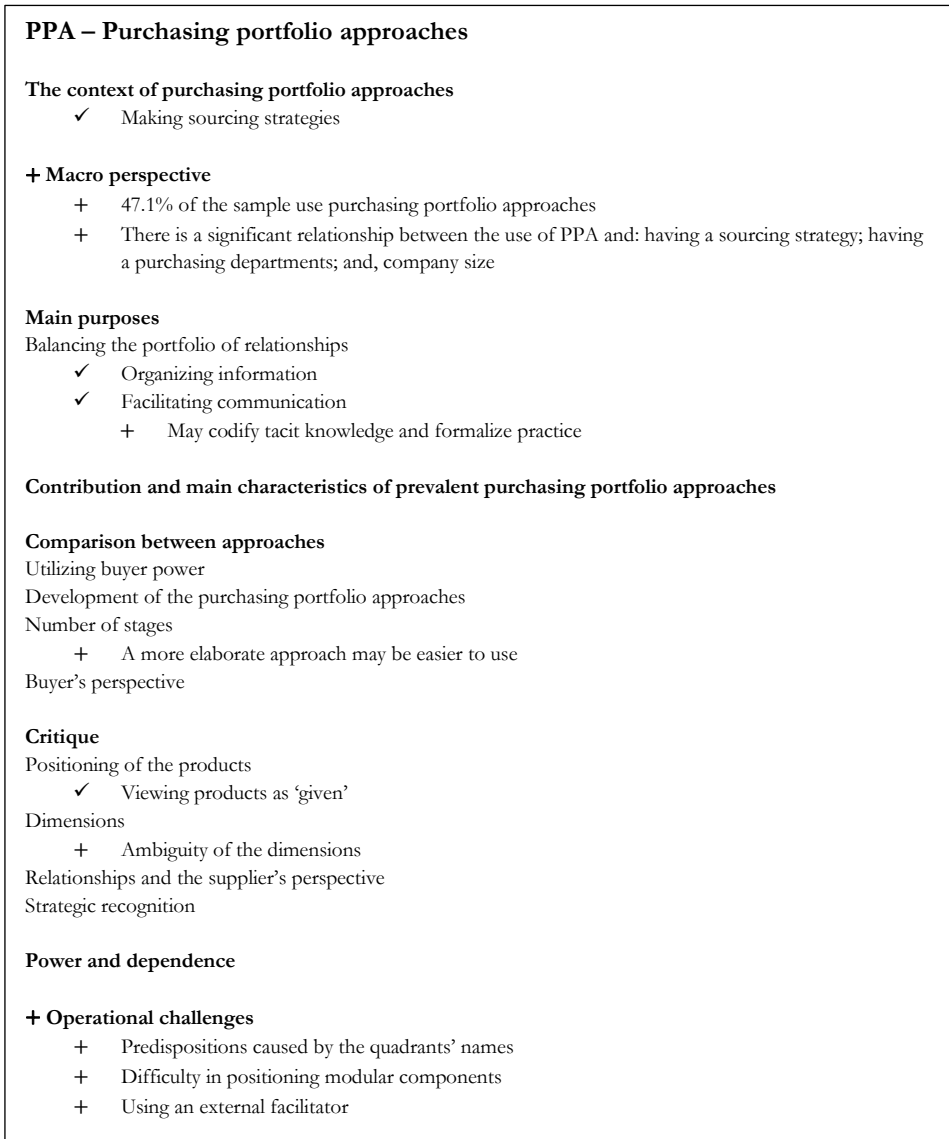


Figure 45: Refined framework with regards to PPA

8.2 Purchasing sophistication

In this section, we seek to refine the theoretical framework (Figure 31) with regards to the topic of purchasing sophistication (PS). The section relies solely on an analysis of survey research findings related to purchasing sophistication. First, we investigate how the level of purchasing sophistication is affected by relevant variables (6.1) of a company. We then proceed by investigating and refining the dimensions of purchasing sophistication, before discussing each dimension in connection to the previously used variables of a company. Finally, we present the refined framework with regards to purchasing sophistication, which will be brought along to the conclusion at the end of this chapter.

Action research findings will not be utilized in this section. This is because we are not able to directly address any of the subjects within the topic of purchasing sophistication with our action research findings; these would have to be considered in relation to the main topics of purchasing portfolio approaches and ETO. Consequently, these findings are postponed to subsequent chapters concerning purchasing sophistication's relation to purchasing portfolio approaches (chapter 9) and ETO (chapter 10), respectively.

8.2.1 Survey research findings

In this subsection, we first present how the level of purchasing sophistication relates to relevant variables of a company (6.1). No similar studies have been identified in theory on purchasing sophistication; hence, these findings will be used to refine our theoretical framework. Furthermore, we discuss our exploratory factor analysis of the multiple-item construct of purchasing sophistication, referring to the *characteristics* of purchasing sophistication and how these relate to each other. Following this, we analyze the factors of purchasing sophistication in relation to relevant variables (6.1) of a company.

Purchasing sophistication in relation to relevant variables

When analyzing the survey data in relation to the level of purchasing sophistication (6.4), the significant relationships in Figure 38 was established. In summary, we discovered that only the possession of a sourcing strategy displayed a statistically significant higher level of purchasing sophistication. We will first discuss and imply a direction of this connection, as we cannot infer causality through the survey research (2.4.5). Thereafter, we discuss possible reasons for why purchasing sophistication's relation to the other variables is not statistically significant, in light of identified literature.

Purchasing sophistication and having a sourcing strategy

When analyzing the survey findings, it was established that companies in possession of a sourcing strategy indeed had a significantly higher purchasing sophistication (6.4.1). However, our survey findings do not reveal the direction of this relationship (2.4.5). In our opinion, either direction would seem plausible. When considering the characteristics of purchasing sophistication (Table 21), we observe conflicting arguments as to which way the connection is directed. It may be the case that higher monetary rewards resulting from a sourcing strategy would increase the attention from top level management (reporting level), and as such increase the level of purchasing sophistication. Further, a sourcing strategy which is aligned with the

business and corporate strategies would probably increase purchasing's strategic importance (*contribution to competitive position*), thus leading to higher sophistication. A sourcing strategy may also have an orientation towards collaborative relationship (*orientation on collaboration*), and/or demand the use of *cross-functional teams*. Such a strategy could also increase the level of purchasing sophistication. On the other hand, a highly sophisticated company would have the skills for *developing strategies*. As such, a high level of sophistication could lead to having a sourcing strategy. In summary, we are in no position to imply a direction of the connection between having a sourcing strategy and level of purchasing sophistication. Nonetheless, we feel that our reasoning is elucidating, and recommend further research at this point.

Purchasing sophistication and having a purchasing department

From the survey analysis, we found that companies with a purchasing department have a somewhat higher purchasing sophistication than companies without a department (6.4.1), as was expected. For instance, a dedicated purchasing function would, in comparison to a company with a scattered responsibility of purchasing (if assigned at all), probably report to top management, as it is recognized as a distinct department. Hence, we would suspect that a purchasing department may lead to a higher average score on reporting level; the first of the characteristics of purchasing sophistication adopted from Gelderman and van Weele (2005) (Table 21; 4.3.1). Further, we argue that a dedicated purchasing department may improve the recognition of purchasing as an important resource to the firm (the second characteristic of purchasing sophistication: table 20), as it is assigned resources, again leading to a higher sophistication. However, despite these prior hypotheses, we did not find the difference in sophistication between companies with a purchasing department and those without, to be significantly different. As such, we conclude that a dedicated purchasing department on its own is not enough to cause a significant increase in purchasing sophistication.

Purchasing sophistication and company size

As previously mentioned (8.1.1), it is identified in theory that larger companies have more resources than smaller firms (6.1.3), which may allow a higher degree of specialization (8.1.1). Further, in relation to company size, it is also worth mentioning that Quayle (2002) discovered that small and medium-sized companies lacked an awareness of the positive effect of effective purchasing on profitability (6.1.3). This discovery may indicate that small and medium-sized companies do not recognize purchasing as an important resource to the firm (a characteristic of purchasing sophistication; Table 21), as they neglect its potential for positively affecting profitability. Gelderman and van Weele (2005) provide, however, an indication of larger companies having a somewhat higher sophistication, by claiming that such companies are more likely to handle more products, suppliers and a more complex sourcing strategy (6.1.3). As such, we found it interesting to see whether company size would make a significant impact on the company's purchasing sophistication.

Contradictory to what we expected from theory, we discovered that there was no significant relationship between company size and a company's level of purchasing sophistication. In fact, both small and medium-sized companies had a higher average level of sophistication than the larger companies. Actually, only about 0.2% of the variance in purchasing sophistication can be

accredited to company size. We also compared SMEs against larger companies, in a similar manner as Quayle (2002), in order to establish if SMEs indeed were less sophisticated. The results proved otherwise; SMEs showed a higher level of sophistication than larger firms. However, the difference was not statistically significant. Consequently, our survey findings imply that company size has little impact on the company's purchasing sophistication.

Purchasing sophistication and purchasing-to-turnover ratio

The variable purchasing-to-turnover ratio was selected as an indicator of the importance of purchasing for a company (6.1.4). As such, we suspected that a company with a high ratio would have recognized the importance of purchasing, thus leading purchasing to higher sophistication, through being an important resource for the company (Table 21). However, in contrast to this assumption, the relationship between purchasing-to-turnover ratio and purchasing sophistication was non-significant. We hence argue that purchasing-to-turnover is a negligible variable when considering a company's level of purchasing sophistication.

Definition of purchasing sophistication

Gelderman and van Weele (2005) found through an exploratory factor analysis that purchasing sophistication is a two-dimensional construct (4.1.4). From our survey research analysis, however, we established that purchasing sophistication is a three-dimensional construct (6.4.3). A definition of each dimension (factor) is provided in Table 49.

DIMENSIONS OF PURCHASING SOPHISTICATION		
Factor	Definition	Description
One	Purchasing position	The internal position and status of the purchasing function in companies
Two	Skills of purchasing professionals	The skills of purchasers in relation to develop strategies and for working in cross-functional teams
Three	Nature of purchasing activities	Indicates to which extent the purchasing function is engaged in clerical duties.

Table 49: Dimensions of purchasing sophistication

Comparing our results from the exploratory factor analysis with the one conducted by Gelderman and van Weele (2005), we discover that our first factor coincides with the one found by the Gelderman and van Weele (4.1.4). This finding strengthens the notion of purchasing's position constituting an indicator of purchasing sophistication, which can be measured with the first two characteristics of purchasing sophistication (reporting level and contribution to competitive position). Hence, we are able to support the findings done by Gelderman and van Weele (2005).

When comparing our last two factors against the second factor provided by Gelderman and van Weele (2005) (4.1.4), we recognize that their second factor comprises both our two remaining factors. Our identified second factor is related to the two indicators measuring the skills of the purchasing professionals, whereas Gelderman and van Weele (2005) (4.1.4) included the

indicator measuring orientation on clerical duties; our third factor. Hence, with respect to our last two factors, we have developed other definitions than Gelderman and van Weele (2005).

Besides having made our survey research on another population than Gelderman and van Weele (2005) did (4.1.4), we do not recognize any reasons for these differences in factors. Nonetheless, we choose to adopt our three-dimensional concept of purchasing sophistication (rather than the two dimensions provided by Gelderman and van Weele) as it is derived from the population to which we are generalizing the results from our survey findings.

Analyzing the factors of purchasing sophistication

Having established that purchasing sophistication is a three-dimensional construct, we here seek to identify whether the relevant variables of a company (6.1) that did *not* have a significant relationship with purchasing sophistication, as a whole, have an effect on the concept at all – utilizing the three underlying constructs of sophistication.

What is immediately apparent is that only two of the relevant variables and a single factor of purchasing sophistication generated any significant results. In detail, the skills of the purchasing professionals (factor two; Table 49) were significantly higher for users of purchasing portfolio approaches compared to non-users. Similarly, having a purchasing department displayed a statistically significant higher level of skills of the purchasing professionals than compared with companies without such a department.

Interestingly, we discovered that company size does not have any significant impact on any of the three factors of purchasing sophistication identified (6.4.3) - this despite the fact that we established a significant relationship between company size and other relevant variables (with the exception of purchase-to-turnover ratio) (8.1.1). However, company size is significantly related to having a purchasing department, which provides a significant difference in the second factor of purchasing sophistication. As such, one could suggest that company size has some impact on purchasing sophistication, though not nearly as much as one could expect, knowing that larger companies have more resources (6.1.3), and as such may have a higher degree of specialization (8.1.1).

Further, the analysis revealed that the purchasing-to-turnover ratio does not show any significant relationships with any of the three identified dimensions of purchasing sophistication. This strengthens our previous supposition of purchasing-to-turnover being a negligible variable when considering a company's purchasing sophistication.

8.2.2 Towards a refined framework – Purchasing sophistication

In this section, we have presented analysis of the findings from the survey research, related to purchasing sophistication. First, we investigated how the level of purchasing sophistication relates to relevant variables of a company (6.1). Here, we found that only having a sourcing strategy displayed a significant result in relation to the level of purchasing sophistication. We were, however, not able to imply a direction for this connection. Nonetheless, we feel that this statistically significant observation should be included in our refined framework under the banner 'level of purchasing sophistication'. Furthermore, we presented our results from an

exploratory factor analysis, indicating that purchasing sophistication is a three-dimensional construct. Hence, our understanding of how the *characteristics* of purchasing sophistication relate to each other was enhanced. This will be included in the refined framework. We then proceeded by investigating the identified dimensions of purchasing sophistication in relation to relevant variables of a company. This investigation indicated that only a single factor, ‘skills of purchasing professionals’ was significantly related to the use of purchasing portfolio approaches and having a purchasing department. These findings are brought along to the refined framework under the banner ‘level of purchasing sophistication’.

From this, we update the theoretical framework developed in Part I (Figure 31) with our findings from the empirical investigation. As in the previous section, we include both validations of identified theory (✓), where this is possible, and additions (+) to the framework. The findings that are to be brought along to the final refined framework, in addition to validations of theory, are illustrated in Figure 45 below.

PS – Purchasing sophistication	
Definition	
Characteristics	+Dimension
Reporting level	✓ Factor 1 – Purchasing position
Contribution to competitive position	
Orientation on collaboration	✓ <i>Cross loaded on several factors</i>
Cross-functional teams	+ Factor 2 – Skills of purchasing professionals
Developing strategies	
Clerical activities	+ Factor 3 – Nature of purchasing activities
+ Level of purchasing sophistication	
+ There is a statistically significant relationship between having a sourcing strategy and the level of purchasing sophistication	
+ There is a significant relationship between using purchasing portfolio analysis and skills of the purchasing professionals	
+ There is a significant relationship between having a purchasing department and skills of the purchasing professionals	
Minimum maturity point	
Purchasing development models	
Critique	

Figure 46: Refined framework with regards to PS

8.3 Engineer-to-order

In this section, we seek to refine the theoretical framework (Figure 31) with regards to the topic of engineer-to-order (ETO). First, we present analysis of the survey research findings, comparing ETO companies with non-ETO companies in respect to relevant variables of a company (6.1), refining the framework with a macro perspective. This is followed by a discussion of action research findings in relation to theory on: *characteristics*; *need for cross-functional integration*; and, *purchasing in ETO companies*. Finally, we present the refined framework with regards to engineer-to-order, which will be brought along to the conclusion at the end of this chapter.

8.3.1 Survey research findings

From our survey research, we were able to extract data on different production situations. Here, we present the findings related to the relationship between ETO and non-ETO companies, to elucidate potential differences related to the investigated variables in the survey research (6.1). In the survey research, a total of 39 ETO companies replied, whereas 40 companies were of a non-ETO production situation³⁰.

When analyzing the survey findings in relation to purchasing-to-turnover ratio, between ETO and non-ETO companies, we found that ETO-companies had a significantly lower purchasing-to-turnover ratio compared to that of non-ETO companies (6.5.2). We argue that this difference may be caused by a higher degree of value-adding production in ETO-companies, compared to non-ETO companies. This is due to the engineering dimension of the production, where an ETO company may reap high margins. As purchasing-to-turnover ratio indicates the importance of purchasing (6.1.4), this may suggest that purchasing has a lower strategic recognition in ETO companies compared to non-ETO companies. We do, however, acknowledge that this relationship needs further investigation.

For the remaining variables investigated, our research findings point to a non-significant difference between ETO and non-ETO companies (6.5). This indicates that there is no notable difference between these production situations in terms of company size, having a purchasing department or utilizing a sourcing strategy. Next, we discuss our action research findings with respect to ETO.

8.3.2 Action research findings

In this subsection, we present and discuss action research findings related to ETO. First, *characteristics* of the ETO production situation are discussed, in terms of products and identified challenges (limited to handling change orders). Second, we empirically validate the *need for cross-functional integration* in ETO companies. Finally, *purchasing in ETO companies* is elucidated by our empirical findings.

³⁰ The remaining respondents were not production companies, and are hence not included in this comparison.

Characteristics

In this paragraph, we first reflect on the characteristics of ETO products, comparing theory with findings from the action research. Thereafter, we investigate one of the identified challenges for ETO companies, handling change orders, in a similar manner.

Product characteristics

We found in theory (5.2.1) that typical characteristics of products in ETO companies are that they are complex, with deep product structures and a high diversity of components; varying in terms of volume, degree of customization and technological advancement (Hicks et al., 2000). When conducting action research (chapter 7), we got thorough insight in the problem holder's components, and were able to validate these product characteristics. We found that the product (buoy) clearly is a complex product, consisting of various components (Table 46). Further, we saw that the buoy's components varied: Some were standardized (e.g. lead batteries); some were customized (e.g. anchorage system); some were of high technological advancement (e.g. data logger); some were of low technological advancement (e.g. lead batteries); and, components varied in terms of volumes (e.g. several batteries per buoy, but only one shell).

In addition, we discovered that an ETO product may consist of modules that are sourced assembled – so called *system sourcing*. These systems may consist of various sub-components with differing characteristics with regards to e.g. degree of customization, price, availability of supply and lead time. Hence, we are able to confirm theory regarding ETO products, in addition to specifying that a diversity of components not only is within the overall product, but in sourced modules as well. This last finding will be brought along to the refined framework at the end of this chapter.

Identified challenges

From theory (5.2.5), we identified that one of the biggest challenges for ETO companies is handling change orders, and that having capabilities to handle such dynamics are a prerequisite for ETO companies (Little et al., 2000). Krajewski et al. (2005) suggest three ways to cope with change orders: the use of supply contracts; the use of suppliers' capabilities; and, the use of postponement (5.2.5).

Through our action research, we learned that the anchorage system was the part of the buoy that was most prone to change orders. The problem holder solved these change orders through the use of *postponement*, in form of waiting to source this module until exact specifications are provided from the customer. Hence, the problem holder has established a routine of sourcing this component at the latest stage possible of the buoy production, to mitigate the risk of a change order. Further, different functions at the problem holder confer with each other, to make sure that change orders accepted by sales/marketing are feasible to do in practice (7.3.1). This face-to-face interaction was enabled by co-location of functions at the same premises; “we work closely because we are close” (second workshop).

In summary, we see that Fugro are utilizing postponement for handling change orders, as described in theory. In addition, co-location of functions facilitates communication across

functions, which in turn reduces the challenge of change orders. This last finding will be brought along to the refined framework at the end of this part.

Cross-functional integration

As identified in ETO theory (5.3), several authors (Konijnendijk, 1994; Kingsman et al., 1993; Hicks et al., 2000) argue that there is a need for cross-functional integration in ETO companies. In action research, however, it was stated that there was no need for cross-functional collaboration when doing purchasing portfolio analysis – as noted in ETO_Observation_5 (7.3.1). One reason for this attitude towards cross-functional collaboration was that, for a small company like the problem holder, the facets between the different departments (such as purchasing and engineering) may be vague, and one often finds oneself working for several functions at once. As such, an employee may possess extensive knowledge of several functions (ETO_Observation_7). In addition, co-location of functions at the same premises enables face-to-face interaction (ETO_Observation_4), making access to information easy, as mentioned above. This may imply that the identified need for cross-functional integration may not necessarily apply to smaller companies with functions co-located at the same premises.

However, in line with the above mentioned challenge of change orders, the problem holders described that previous problems with change orders were caused by a lack of cross-functional coordination. This led us to make ETO_Observation_6 (7.3.1). As such, we argue that there is a general need for *cross-functional coordination* in ETO companies, with cross-functional *integration* being an extreme of coordination. Cross-functional integration may be most applicable for larger companies, whereas coordination seems to suffice for smaller companies, where the facets between functions are vague. Hence, we refine the need for cross-functional integration, and bring this along to the refined framework.

Purchasing in ETO companies

In theory (5.4), we identified that the purchasing practice of ETO companies is characterized as reactive, clerical, often using a lowest price strategy and adversarial trading approaches (Hicks et al., 2000). In action research, however, we found that a lowest price strategy not always is followed, even though price is important for Fugro. The company does search for alternative suppliers, in order to establish alternatives and as a means for comparing prices (ETO_Observation_11). However, quality, delivery time and stability, proximity and communication were mentioned as the most important aspects when choosing suppliers (ETO_Observation_8). We argue that this may be because the company sources some components that are engineered for each buoy, and therefore varies (as discussed in 8.1.2). As such, they need to know which capabilities the supplier possesses, in order to evaluate if the supplier can provide the varying component (e.g. supply anchorage systems suitable for both the North Sea and the Indian Ocean). Hence, the suppliers' ability to deliver the required components may be more important than having the lowest price.

Further, adversarial trading approaches were not identified; rather, many of the supplier relationships mapped can be characterized by continuity and trust (ETO_Observation_22). Through continuity and trust, the problem holder has developed long-term relationships, which

were characterized as difficult to terminate, as the relationships often evolve into what the problem holder termed ‘friendships’. As such, the problem holder finds that a long-term relationship is natural to prolong, even though the nature of the relationship changes (ETO_Observation_9). The problem holder has found that long-term relationships may increase the priority from the supplier (ETO_Observation_14) and lead to development of valuable knowledge of the suppliers’ operations (ETO_Observation_12). Even though long term relationships seem to be of high value for Fugro, they use few contractual agreements towards suppliers (ETO_Observation_10).

We believe that this finding may be due to the characteristic of the relationships as ‘friendships’; arguing that trust, experience and continuity may mitigate the risk of opportunism and adversarial trading. However, the friendship characteristic may also hinder Fugro from switching between potential suppliers to achieve lower prices, as they do not want to break the relationships. As such, we see both advantages and disadvantages of developing a ‘friendship’ with the supplier. In addition, the aversion towards using contractual agreements may also be caused by challenges concerning the specifications of sourced components that vary (c.f. the beginning of this paragraph).

Further, we have identified in theory (5.4) that research on purchasing has been dominated by studies on supply chains where a focal producer has high buyer power (Cox, 2004). In the ETO setting, however, the characteristics are different, and the same assumptions do not hold for buyer-supplier relationships; a diversity of factors implies that caution must be made when comparing literature on the high-volume sector with the low-volume sectors (Hicks et al., 2000). These theoretical findings were confirmed by conducting action research. First, we found that for a small company like the problem holder, it is difficult to initiate close (resource intensive) relationships with large suppliers (ETO_Observation_15). The company may receive lower priority from the supplier; e.g., your orders may be pushed back in line due to larger orders from more important customers (ETO_Observation_13). As such, we see a power disadvantage for companies with similar characteristics as Fugro.

While we have identified in theory that the power balances may be of a different nature for ETO companies (see above), it does not state how ETO companies may mitigate such challenges. However, the action research problem holder had solved this problem by purchasing higher volumes when possible (ETO_Observation_18), and further bundling volumes across subsidiaries for some product (ETO_Observation_17). As such, bargaining power and attention from their suppliers was gained (ETO_Observation_18; 20). We see that it may be advantageous with a reduced supply base; consolidating volumes toward few suppliers to gain priority and bargaining power. Interestingly, power issues like these are not considered in Fugro prior to choosing suppliers; rather, they are experienced *ex post* (ETO_Observation_21). In the next subsection, we conclude on which findings to be included in the refined framework, under the topic of engineer-to-order.

8.3.3 Towards a refined framework – Engineer-to-order

We have in this section presented analysis of the findings from both survey and action research. First, we took a macro perspective, and investigated how ETO companies compare to non-

ETO companies by using our survey research findings. Here, we discovered that the only significant difference between ETO- and non-ETO companies was that ETO has a statistically significant lower purchasing-to-turnover ratio. These findings will be brought along to the refined framework, constituting a macro perspective.

Thereafter, we discussed our action research findings in relation to theory on *characteristics* (in terms of products and challenges) of ETO companies. Here, we confirmed the theory concerning product structure, and further argued that the complex product structure not only applies for the ETO product itself, but also for sourced components (e.g. through systems sourcing). This will be included in the refined framework. With respect to an *identified challenge* concerning change orders, we confirmed that the problem holder utilized postponement as a strategy for handling this challenge. In addition, we found that co-location of functions facilitates communication across functions, which in turn reduces the challenge of change orders. This last finding will be brought along to the refined framework. When investigating the *need for cross-functional integration* in ETO companies, we reckoned that cross-functional *coordination* may suffice for smaller companies, where the facets between functions are vague and the functions are co-located at the same premises. This will be added in the refined framework. Finally, we presented a discussion concerning the practice of *purchasing in ETO companies*. Here, we found that all ETO companies not necessarily follow a lowest price strategy. Further, we found that several supplier relationships are characterized as ‘friendships’, in terms of trust and continuity. Finally, we found that bargaining power may be achieved through purchasing large volumes, possibly through bundling volumes across subsidiaries.

From this, we update the theoretical framework developed in Part I (Figure 31) with our findings from the empirical investigation. As in the previous sections, we include both validations of identified theory (✓), where this is possible, and additions (+) to the framework. The findings that are to be brought along to the final refined framework, in addition to validations of theory, are illustrated in Figure 45 below.

ETO – Engineer-to-order

Definition

+ Macro perspective

- + ETO companies have a significantly lower purchasing-to-turnover ratio than non-ETO companies
- + ETO companies are not different from non-ETO companies regarding company size, having a purchasing department, or utilizing a sourcing strategy

Characteristics

Products

- ✓ Deep product structures
- + Complexity not only in the final product, but also in sourced components/systems

Processes

Markets

Risk and uncertainty

Identified challenges

- ✓ Postponement is used to handle change orders
- + Communication across functions, facilitated by co-location, may reduce the challenge of change orders

Need for cross-functional integration

- + Cross-functional coordination may suffice for smaller companies, where the facets between functions are vague and the functions are co-located at the same premises

Purchasing in ETO companies

- + All ETO companies do not necessarily follow a lowest price strategy
- + Several supplier relationships are characterized as 'friendships', in terms of trust and continuity
- + Bargaining power may be achieved through purchasing large volumes, possibly through bundling volumes across subsidiaries

Figure 47: Refined framework with regards to ETO

8.4 Conclusion

As described in the introduction to this fourth part, the purpose of this chapter was to refine the theoretical framework developed in Part I (Figure 31), using empirical findings from both survey and action research (Part II), in order to fully answer our first research question (c.f. 2.1.3); what are important features of purchasing portfolio approaches, purchasing sophistication and engineer-to-order?

We have in the three preceding sections validated and refined the theoretical framework with respect to purchasing portfolio approaches (8.1; Figure 45), purchasing sophistication (8.2; Figure 46) and engineering-to-order (8.3; Figure 47). The total refined framework, which answers the first research question, is provided in Figure 48 below. Empirical validations of theory are not included. The reader is referred to the preceding sections (8.1-8.3) for this discussion. As mentioned in both the methodology (2.1.3) and the introduction to this part, the refined framework is further used in the subsequent analysis, in guiding the answering of RQ2-4.

PPA – Purchasing portfolio approaches

The context of purchasing portfolio approaches

Making sourcing strategies

+ Macro perspective

- + 47.1% of the sample use purchasing portfolio approaches
- + There is a significant relationship between the use of PPA and: having a sourcing strategy; having a purchasing departments; and, company size

Main purposes

Balancing the portfolio of relationships

Organizing information

Facilitating communication

- + May codify tacit knowledge and formalize practice

Contribution and main characteristics of prevalent purchasing portfolio approaches

Comparison between approaches

Utilizing buyer power

Development of the purchasing portfolio approaches

Number of stages

- + A more elaborate approach may be easier to use

Buyer's perspective

Critique

Positioning of the products

Dimensions

Relationships and the supplier's perspective

Strategic recognition

Power and dependence

+ Operational challenges

- + Predispositions caused by the quadrants' names
 - + Difficulty in positioning modular components
 - + Using an external facilitator
-

Purchasing sophistication	
Definition	
Characteristics	+Dimension
Reporting level	✓ Factor 1 – Purchasing position
Contribution to competitive position	
Orientation on collaboration	✓ <i>Cross loaded on several factors</i>
Cross-functional teams	
Developing strategies	+ Factor 2 – Skills of purchasing professionals
Clerical activities	+ Factor 3 – Nature of purchasing activities
+ Level of purchasing sophistication	
+ There is a statistically significant relationship between having a sourcing strategy and the level of purchasing sophistication	
+ There is a significant relationship between using purchasing portfolio analysis and skills of the purchasing professionals	
+ There is a significant relationship between having a purchasing department and skills of the purchasing professionals	
Minimum maturity point	
Purchasing development models	
Critique	
ETO – Engineer-to-order	
Definition	
+ Macro perspective	
+ ETO companies have a significantly lower purchasing-to-turnover ratio than non-ETO companies	
+ ETO companies are not different from non-ETO companies regarding company size, having a purchasing department, or utilizing a sourcing strategy	
Characteristics	
Products	
+ Complexity not only in the final product, but also in sourced components/systems	
Processes	
Markets	
Risk and uncertainty	
Identified challenges	
+ Communication across function, facilitated by co-location, may reduce the challenge of change orders	
Need for cross-functional integration	
+ Functional coordination may suffice for smaller companies, where the facets between functions are vague and the functions are co-located at the same premises.	
Purchasing in ETO companies	
+ All ETO companies do not necessarily follow a lowest price strategy.	
+ Several supplier relationships are characterized as 'friendships', in terms of trust and continuity.	
+ Bargaining power may be achieved through purchasing large volumes, possibly through bundling volumes across subsidiaries.	

Figure 48: Refined framework

9 Purchasing portfolio approaches and purchasing sophistication

The intention of this chapter is to evaluate the link between purchasing portfolio approaches and purchasing sophistication, and as such, provide an answer to our second research question; *what is the relationship between purchasing sophistication and the use of purchasing portfolio approaches?* This research question is answered mainly on the basis of survey research (cf. 2.1.3); however, action research findings will be utilized to support our inferences and conclusions. We will draw on discussions made in chapter 8, concerning the topics of purchasing portfolio approaches (8.1) and purchasing sophistication (8.2), and discuss how these are coupled.

In the first section, we present our survey research findings, establishing the link between the two topics of purchasing portfolio approaches and purchasing sophistication. In the second section, we use action research findings to support the survey findings, and for refuting our proposed relation between purchasing sophistication and tool complexity, introduced in the specialization project (1.1.6; Figure 6). A new, improved, framework is then presented, segmenting between the presented prevalent purchasing portfolio approaches, with regard to purchasing sophistication. In the final section, we conclude this chapter by answering RQ2.

9.1 Findings from survey research

This section presents the findings from our survey research in relation to the connection between the topics of purchasing portfolio analysis and purchasing sophistication. The first subsection establishes the link between the research topics in analysis, before the second subsection seeks to disarm critique of purchasing portfolio approaches in relation *to purchasing's strategic recognition* (Table 17).

9.1.1 Purchasing portfolio analysis' connection to purchasing sophistication

As discussed in section 8.2, we established that a company possessing a sourcing strategy has a statistically significant higher level of purchasing sophistication, compared to companies lacking a sourcing strategy (8.2.1). In addition, when analyzing the use of purchasing portfolio approaches, we discovered a significant relationship, indicating that users of purchasing portfolio analysis are more likely to have a sourcing strategy than non-users (8.1.1). Further elaborating on the latter finding, we argued that since purchasing portfolio approaches are applied in the process of developing sourcing strategies (3.1.1), it is fair to assume that the use of purchasing portfolio approaches leads to the development of a sourcing strategy, and not the other way around (8.1.1). Hence, we implied a direction on this significant relationship between using purchasing portfolio approaches and having a sourcing strategy. As such, there is a connection between the use of a purchasing portfolio approach and the level of sophistication of a company's purchasing function, as illustrated in Figure 49 below. However, we acknowledge that we are not able to determine the direction of the relationship between having a sourcing strategy and the level of purchasing sophistication (8.2.1).

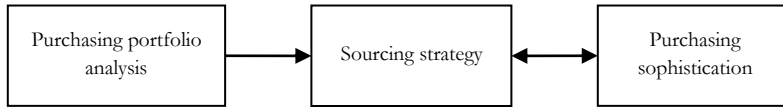


Figure 49: The connection between purchasing portfolio analysis and purchasing sophistication

Further, we found support for this connection from our analysis of the three factors of purchasing sophistication: purchasing position; skills of purchasing professionals; and, nature of purchasing activities (8.2.1). This analysis established that users of purchasing portfolio analysis had a significantly higher level of skills, compared to non-users. This factor of purchasing sophistication is measured by two indicators; the skills to develop strategies, and the skills to participate in cross-functional teams (8.2.1). In relation to the first indicator, it is identified in theory that an appreciated characteristic of purchasing portfolio approaches is that they provide practical guidelines for managing different supplier relationships (3.3.1). In addition, the context of using a purchasing portfolio approach is to make sourcing strategies (3.1.1). Consequently, it is reasonable to suggest that such an approach is appropriate for purchasers who do not have sufficient skills in developing sourcing strategies. As such, we argue that use of purchasing portfolio analysis may facilitate the development of skills, and thus purchasing sophistication of the purchasing function.

In relation to the second indicator of purchasing professionals skills, skills to participate in cross-functional teams, we identified from theory that the use of a purchasing portfolio approach may be a means for facilitating cross-functional coordination (3.3.1), and that it may enable non-purchasing professionals to evaluate and discuss purchasing issues (3.3.1). Hence, theory indicates that the use of purchasing portfolio approaches may facilitate the development of skills to participate in cross-functional teams. In this way, the use of PPA will increase sophistication of the purchasing function.

In summary, we argue that the use of purchasing portfolio analysis may help to increase the purchasing sophistication through a higher level of skills pertaining to the purchasing professionals (Figure 50). As such, we establish an even stronger connection between the use of purchasing portfolio analysis and the level of purchasing sophistication. This connection will further be used to address critique of purchasing portfolio approaches in the next subsection.

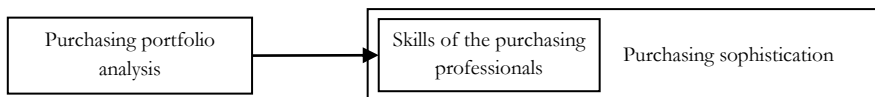


Figure 50: Purchasing portfolio analysis as a facilitator for developing skills

9.1.2 Addressing critique with our proposed connection

Dubois and Pedersen (2002) criticize the use of purchasing portfolio models, in stating that such models impede the strategic recognition of purchasing (3.5.2; Table 17). One of their arguments is that the use of a purchasing portfolio model implies that the purchasing function has a mere clerical function within the company (Table 17). The sixth characteristic of purchasing sophistication, adopted from Gelderman and van Weele (2005; 4.3.1), is ‘clerical activities’. According to Gelderman and van Weele (2005), clerical activities are a sign of low purchasing sophistication (Table 21). As such, we argue that the critique given by Dubois and Pedersen (2002) actually implies that the use of purchasing portfolio models obstructs, rather than facilitates, the development of a purchasing function’s level of sophistication.

In 4.3.1, we adopted the definition of purchasing sophistication by Pearson and Gritzmacher (1990, p.93); “the sophistication level of purchasing within an organization determines to a great extent its role in and integration into the strategic management decision making process”. This definition implies that a higher level of sophistication corresponds to a higher strategic recognition of purchasing. As mentioned in 9.1.1, users of purchasing portfolio analysis are more likely to have a sourcing strategy than non-users. Further, we have established that companies possessing a sourcing strategy have a significantly higher level of purchasing sophistication than companies in lack of such a strategy (9.1.1). As such, we argue that our proposed connection from our survey findings, between the use of purchasing portfolio approaches and the purchasing function’s level of sophistication, to a large extent refutes this criticism of purchasing portfolio approaches, in that the use of purchasing portfolio approaches may increase purchasing’s strategic recognition.

We acknowledge that the arguments by Dubois and Pedersen (2002) may be valid for some companies; however, we argue that our survey findings indicate that this may be an exception, and that the use of purchasing portfolio approaches can be associated with a higher level of purchasing sophistication. From this, we now turn to our action research findings; further addressing the link between purchasing portfolio approaches and purchasing sophistication.

9.2 Findings from action research

In this section we will provide our findings from action research that relate to the connection between the topics of purchasing portfolio approaches and purchasing sophistication. First, we attempt to direct the significant relationship between the use of purchasing portfolio approaches and the second factor of purchasing sophistication (skills of purchasing professionals); as such implying causality to the extent possible. Thereafter, we discard the proposed relationship between purchasing sophistication and tool complexity that was developed in the specialization project (1.1.6). Finally, we develop a segmentation model for the purchasing portfolio approaches identified in theory, by using characteristics of purchasing sophistication.

9.2.1 The skills of the purchasing professionals

From our survey research findings (9.1.1), we established two connections between the use of purchasing portfolio analysis and the company’s level of purchasing sophistication (Figure 49 and Figure 50). In this subsection, we will further elaborate on the direction of these

relationships, based on our findings from action research. Even though we discovered two connections, our findings from the action research only addresses the latter, which suggests that purchasing portfolio approaches may be a facilitator for developing skills of the purchasing professionals; as such increasing the level of sophistication of the purchasing function (Figure 50).

The second factor of purchasing sophistication is determined by two characteristics; skills in developing strategies and participating in cross-functional teams (8.2; Figure 46). In relation to the latter characteristic, the action research did not uncover any relevant observations or discussions as to whether the skills to participate in cross-functional teams were enhanced during the workshops. This was somewhat expected, as we argue that it takes time and training to develop such skills. Further, the same line of argument applies for the second indicator of the skills of purchasing professionals. We found that the participants were positive to the use of such an approach, as it was stated that they found the concept interesting and considered it valuable starting point for developing strategies (7.6). We were, however, not able to see a development of skills during the workshops. We argue that these observations stems from the time constraint of the action research – one cannot expect development from only a total of two hours of application. We do, however, believe that if we had been able to fulfill the action research cycle (2.3.4), using purchasing portfolio approaches over time, the participants would adapt to using such approaches. As such, they would likely have enhanced their skills in developing strategies and participating in cross-functional teams.

9.2.2 Discarding the proposed relationship between purchasing sophistication and tool complexity

In our specialization project, we proposed a connection between the required level of purchasing sophistication and the comprehensiveness of various purchasing portfolio approaches (1.1.6; Figure 6). As depicted in Figure 10 (1.2), this connection was challenged through empirical testing (action research) in this master's thesis. According to our proposed connection, the Kraljic approach (1983) should be easier to use than the approach by Olsen and Ellram (1997), due to its argued lower tool complexity (Figure 6). However, when refining our framework in relation to the topic of purchasing portfolio approaches (8.1.2), we found that the extensiveness of the approaches not necessarily reflects their difficulty of use. Here, we argued that a comprehensive approach may be easier to use, as its guidelines may be more elaborate. As such, the approach may be more specified, and thus less complex, because complexity is divided up into subcategories and underlying measures. As such, tool complexity is regarded to be an insufficient dimension to utilize in differentiating the purchasing portfolio approaches.

Further, in the proposed model, the sophistication dimension was proposed on the basis of an understanding of purchasing sophistication as “professionalism of the purchasing function” (1.1.6). However, by investigating the concept of purchasing sophistication in depth in this master's thesis (chapter 4), we learned that sophistication may be described by six characteristics (4.3.1; Table 21). These characteristics are not limited to the skills of the purchasing function (c.f. professionalism, as was our prior assumption). As such, we see that a model should preferably incorporate an understanding of purchasing sophistication beyond what was not

limited to the insufficient definition of purchasing sophistication as ‘professionalism of the purchasing function’, but based on its underlying characteristics.

We still feel that a segmentation of the most prominent purchasing portfolio approaches is beneficial, as we have discarded the proposed model from the specialization project. Schiele (2007) proposes that a minimum maturity point exists, under which the implementation of best practices defeats its own end (4.1.5). We argue that due to the differences of the purchasing portfolio approaches (e.g. in terms of number of stages and utilizing buyer power; 3.4.2), they have different minimum maturity points. Following this line of argument, it would be counterproductive to implement a purchasing portfolio approach with a higher minimum maturity point than your current level of sophistication. If this was the case, the use of the purchasing portfolio approach would possibly consume more resources than the approach would provide benefits. As such, the recognition of purchasing as a contributor to competitive advantage (Table 21) could probably be compromised, due to disadvantageous usage of the company’s resources; hence reducing the level of purchasing sophistication. In the next subsection, we develop a new segmentation model which incorporates stronger concerns for purchasing sophistication.

9.2.3 Segmenting purchasing portfolio approaches

In this subsection, we develop a segmentation model including the most prevalent purchasing portfolio approaches (3.4) based on the six characteristics of purchasing sophistication by Gelderman and van Weele (2005) (Table 21). First, we discuss the characteristics’ ability to segment the purchasing portfolio approaches. Then, each approach is discussed and evaluated according to relevant characteristics of sophistication. Finally, we conclude with a model segmenting the different approaches.

Relevant characteristics of purchasing sophistication in relation to purchasing portfolio approaches

We here discuss each of the characteristics of purchasing sophistication (Table 21), in relation to its ability to separate between different purchasing portfolio approaches. First, we argue that both *reporting level* and *contribution to competitive position* are organizational aspects of purchasing sophistication. From our survey research, we established a connection between these two characteristics, in that they constitute the first factor of purchasing sophistication (‘Purchasing’s position’; 8.2.1). Further, in the action research, we discovered that the implementation of a purchasing portfolio approach may be viewed as a political decision, in that top management must allocate time and resources for this purpose (PPA_Observation_20). This observation clearly relates to the first identified factor of purchasing sophistication (8.2.1), in that it implies both *top management attention* and the *perceived importance of purchasing*. We argue that these characteristics are unfit to distinguish between different approaches; they are, however, important determinants for the implementation of a purchasing portfolio approach.

Further, we argue that *orientation on collaboration* may be used to segment the purchasing portfolio approaches, as we found that the approaches differ with respect to, e.g., the utilization of buyer power (3.4.2). As such, we will utilize this characteristic when segmenting the approaches.

Further, in relation to the second factor of purchasing sophistication ('Skills of purchasing professionals'; 8.2.1), comprising the *skills of participating in cross-functional teams* and *developing strategies*, we argue that this factor as a whole cannot be used to segment the approaches. As such, we see it beneficial to separate between the two indicators. First, we argue that the skills to participate in cross-functional teams may be facilitated by the use of purchasing portfolio approaches (3.3.1; 9.1.1), and that this is an advantage provided by all purchasing portfolio approaches; not limited to a specific approach. Consequently, we will not use this characteristic when segmenting the approaches. However, we argue that the required skills associated with *developing strategies* will vary between the approaches, as they differ in terms of providing explicit strategies and guidelines. Hence, this characteristic is brought along to the segmentation of the approaches.

Finally, the last identified factor of purchasing sophistication ('Nature of purchasing activities'; 8.2.1) indicates the orientation on clerical duties. We argue clerical activities typically would lie below the minimum maturity point of using purchasing portfolio approaches; a portfolio analysis requires a strategic mindset, beyond what recognizes clerical activities. Hence, a strategic mindset could be argued to be a prerequisite for using any purchasing portfolio approach. As such, we conclude that orientation on clerical duties cannot be used to separate the approaches.

In the following paragraphs, we discuss more specifically how the relevant characteristics of purchasing sophistication (*orientation on collaboration* and *developing strategies*) may be used to separate the different purchasing portfolio approaches, and how each of the prevalent purchasing portfolio approaches relates to the chosen characteristics.

Orientation on collaboration

First of all, we argue that orientation on collaboration has two extremes; at one side, buyer power is utilized towards the supplier, whereas partnership sourcing is in contrast to this at the other side. As such, this provides a dimension for segmentation— *orientation on collaboration* – for distinguishing between the prevalent purchasing approaches.

Kraljic (1983) clearly states his position in relation to the orientation on collaboration, emphasizing that the generated sourcing strategy generally must enable the company to exploit its buyer power against its suppliers – at a lowest possible risk (3.4.2). This is also evident in his second portfolio matrix (3.4.1), where a determination of the relative bargaining power of the company is made (Figure 21). As such, Kraljic (1983) represents a purchasing portfolio approach with a low orientation on collaboration (i.e. emphasis on utilizing buyer power).

The approach by Elliot-Shircore and Steele (1985) does not discuss the usage of buyer power explicitly (3.4.2), which may suggest that the authors have recognized the potential benefits of collaborating with suppliers through partnership sourcing, and the danger of purely relying on utilizing buyer power. This would be an indication of higher level of purchasing sophistication (Table 21). However, as Elliot-Shircore and Steele (1985) never explicitly mention the benefits of close partnerships with suppliers, we argue that this is not the case. This argument is strengthened by the fact that the suggested actions for the different category blocks are focused

on negotiation and monitoring of suppliers (3.4.2). This is an indication of confrontational sourcing, which may be caused by a focus on buyer power. Further, the portfolio model employed in the approach by Elliot-Shircore and Steele (1983) evaluates each purchased product according to its supply vulnerability and value potential (Table 16). As such, there is no need for more information about the supplier than what is readily available, in order to categorize the sourced products. Hence, we argue that the purchasing function can rely on a confrontational sourcing practice. Consequently, the approach by Elliot-Shircore and Steele (1985) has a somewhat intermediate focus on whether to utilize buyer power in relation to their suppliers.

As mentioned in the comparison of purchasing portfolio approaches (3.4.2), van Weele (2010) builds his approach on the purchasing portfolio approach by Kraljic (1983) (3.4.1), and shares his focus on utilizing buyer power. This is supported by the following statement: “In the author’s view the balance of power should preferably be in favor of the [buyer]... Obviously, when a company is too dependent on a supplier, something should be done to change the situation” (van Weele, 2010, p.195; 3.4.2). Hence, we argue that there are few differences in relation to orientation on collaboration between the approaches by Kraljic (1983) and van Weele (2010). Consequently, van Weele (2010) represents a purchasing portfolio approach with a low orientation on collaboration (i.e. emphasis on utilizing buyer power).

Olsen and Ellram (1997) provide a purchasing portfolio approach which realizes the danger associated with utilizing buyer power in a fluctuating competitive environment (3.4.2). As such, this approach is not concerned with utilizing buyer power, but rather to collaborate with the suppliers. This indicates that the approach will not be fully appreciated until the purchasing function starts to realize the potential of collaborating with the suppliers; moving away from a focus on utilizing purchasing power. This is further supported by the fact that the authors developed their approach with the purpose of managing a company’s different suppliers (Table 16). Consequently, we argue that the approach by Olsen and Ellram (1997) represents one of the approaches with the highest orientation on collaboration.

When comparing the prevalent purchasing portfolio approaches (3.4.2), we discovered that Bensaou (1999) lies somewhat between the two extremes mentioned above, similar to Elliot-Shircore and Steele (1985). However, while Elliot-Shircore and Steele (1985) are implicitly using utilizing buyer power in their generic strategies, the approach by Bensaou (1999) uses power and dependence in relation to both the dimensions in his approach. Further, Bensaou (1999) does not provide any generic strategies, and as such we cannot determine to which extent this aspect of the approach is inspired by orientation on collaboration. Consequently, we argue that the approach by Bensaou (1999) has an intermediate orientation on collaboration.

Finally, Nellore and Söderquist (2000) provide the only purchasing portfolio approach which takes the supplier’s perspective, evaluating the supplier’s capabilities and capacities (3.4.2). As the approach by Nellore and Söderquist (2000) requires such an evaluation, we argue that such detailed information about the suppliers can only be achieved in a form of partnership; one rarely attains this type of information from confrontational supplier relationships where buyer power is utilized. However, we acknowledge that a large buyer, who is a vital customer for the

supplier, could demand such information without having to engage in a form of partnership. Nevertheless, we argue that this is an exception, and thus conclude that Nellore and Söderquist (2000) have a high orientation on collaboration.

Developing strategies

According to Gelderman and van Weele (2005), purchasing personnel in companies with a more sophisticated approach to purchasing will have the skills to develop differentiated purchasing and supplier strategies (4.1.4; Table 21). However, in our opinion, the purchasing portfolio approaches vary with respect to the completeness of the provided generic strategies. Hence, we argue that the least detailed generic strategies require higher skills of the purchasing professionals in developing sourcing strategies, and vice versa. This was also found in action research as the participants preferred the approach by Olsen and Ellram (1997) over the Kraljic matrix (1983)(PPA_Observation_15). As such, this provides the second dimension – *required skills for developing strategies* – for distinguishing between the prevalent purchasing approaches.

Starting with the approach by Kraljic (1983), we identify that the approach provides only generic strategies for the products classified as strategic (3.4.1). Hence, the purchaser must use his own skills in developing strategies for the remaining three product categories. We argue that this implies a high level of skills required in developing strategies. However, Kraljic (1983) provides comprehensive strategies for strategic components (3.4.1). Thus, we argue that Kraljic (1983) has a somewhat intermediate requirement for skills in developing strategies.

The purchasing portfolio approach by Elliot-Shircore and Steele (1985) is among the least extensive, as it has only one stage within the approach (Table 16). Further, the approach provides characteristics, suggested actions and aims for the four different “category blocks” (Table 16). As such, it provides complete generic strategies for all products placed in the matrix. Hence, we argue that the approach by Elliot-Shircore and Steele (1985) requires low skills for developing sourcing strategies.

As mentioned when comparing the different purchasing portfolio approaches (3.4.2), van Weele (2010) builds his approach on the one developed by Kraljic (1983), however, he provides generic strategies for all product categories in the employed portfolio model. Consequently, we argue that the approach by van Weele (2010) has a low requirement for the practitioners’ skills in developing strategies.

In the remaining three approaches, there is a fundamental change in relation to their extensiveness, as they employ 2-3 portfolio models each (3.4.1). These remaining approaches analyze both *how the current sourcing strategy is implemented* and *how the strategy should be* (3.4.1).

The purchasing portfolio approach by Olsen and Ellram (1997) is somewhat different to the two other remaining purchasing portfolio approaches, in that it provides elaborate guidelines as to how to use it, and the most complete generic strategies (3.4.2). These guidelines take the form of comprehensive lists of factors to measure for each dimension, descriptions of each quadrant in the portfolio matrices employed, and prioritization guidelines for the different suggested action plans (generic strategies). Hence, we argue that, despite analyzing current strategy and how it

should be, the approach by Olsen and Ellram (1997) has a low required level of skills for its use. This reasoning is supported by PPA_Observation_15.

Bensaou (1999) developed his purchasing portfolio approach with the objective of ensuring that the portfolio of relationships is effectively managed and adapted to their external context (3.4.1). However, the author does not provide any generic strategies, rather appropriate management profiles (3.4.2). As such, much of the work of forming sourcing strategies for each product is left to the practitioner. Hence, we argue that the purchasing portfolio approach by Bensaou (1999) requires a high level of skills in developing strategies.

The last of the prevalent purchasing portfolio approaches is the one developed by Nellore and Söderquist (2000). Out of the approaches discussed, this consists of the most steps (Table 16). As previously mentioned, it is the only purchasing portfolio approach which explicitly forces the practitioner to take the suppliers view of the sourcing practice (3.4.2). Hence, we argue that it is beneficial for the user to have a certain strategic mindset before initiating this approach. Further, the approach by Nellore and Söderquist (2000) adopts parts of the same portfolio models by Olsen and Ellram (1997). However, Nellore and Söderquist (2000) do not provide the same elaborate description, neither with respect to how to use the approach, nor of the generic strategies (3.4.2). Consequently, we argue that the purchasing portfolio approach by Nellore and Söderquist (2000) demands a high level of skills to develop sourcing strategy. In the next paragraph, we summarize this discussion through placing each approach in a segmentation model.

A segmentation model for purchasing portfolio approaches

We have now presented an evaluation of each prevalent purchasing portfolio approach according to orientation on collaboration and the required skills for developing strategies. This discussion is summarized by placing the different approaches in the model depicted in Figure 51 below. As such, we have successfully made a segmentation of the most prevalent purchasing portfolio approaches, with regards to purchasing sophistication.

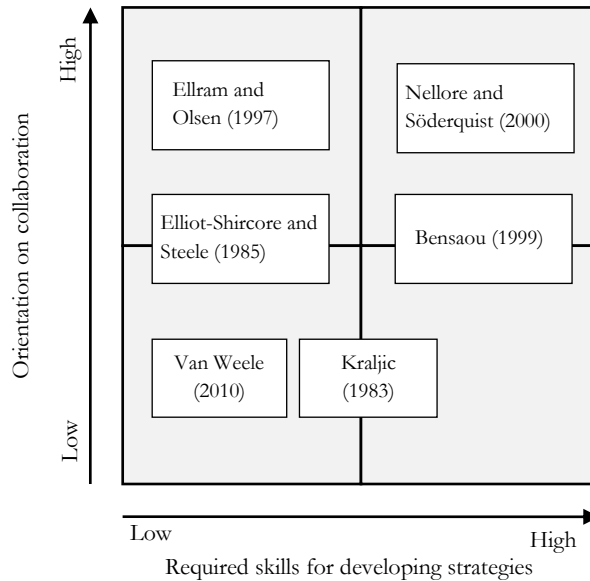


Figure 51: Framework for selecting a purchasing portfolio approach

Further, we argue that this model may be utilized as a framework for selecting a suitable purchasing portfolio approach. Through evaluating a company’s level of purchasing sophistication in terms of orientation on collaboration and current level of skills in developing strategies, the framework will provide suggestions as to which purchasing portfolio approach the company should employ, by incorporating a concern for the minimum maturity point.

9.3 Conclusion

In this chapter, we have investigated the link between purchasing portfolio approaches and purchasing sophistication. We established, through survey research, two connections between the use of purchasing portfolio approaches and the level of purchasing sophistication: (1) The use of purchasing portfolio approaches may lead to the development of a sourcing strategy, which in turn is found to have an impact on purchasing sophistication; and (2) the use of a purchasing portfolio approach may lead to the development of the skills of the purchasing professionals (second identified factor of purchasing sophistication).

From action research, we saw the need to discard the previously proposed model connecting purchasing portfolio model and tool complexity. We then established a new segmentation model for purchasing portfolio approaches, based on two purchasing sophistication characteristics; *orientation on collaboration* and *skills for developing strategies*. This model may be used to recommend a purchasing portfolio approach, given a company’s purchasing sophistication.

Through establishing two connections between the use of purchasing portfolio approaches and the level of purchasing sophistication, and providing a model for segmenting such approaches

with regards to purchasing sophistication, we argue that we have answered our second research question in an elaborate and satisfying manner.

10 Purchasing sophistication of ETO companies

The intention of this chapter is to evaluate the link between purchasing sophistication and the engineer-to-order production situation, and as such, provide an answer to our third research question; *how is purchasing sophistication reflected in the purchasing practice of ETO companies?* This research question is answered mainly on the basis of action research; however, survey findings will be utilized to support our inferences and conclusions. We will draw on discussions made in chapter 8, concerning the topics of purchasing sophistication (8.2) and engineer-to-order (8.3), and discuss how these are coupled. We will also utilize empirical findings that are postponed to this chapter.

First, the survey findings related to the purchasing sophistication of ETO companies are provided. Then, we seek evaluate ETO companies' purchasing sophistication through action research, employing both the concept of developments models and purchasing sophistication characteristics. Finally, we provide a conclusion which answers our third research question.

10.1 Findings from survey research

From our survey research, we were able to measure the average sophistication of Norwegian ETO companies. This is presented and discussed in the following sub-section.

10.1.1 Sophistication of Norwegian ETO companies

Recapitulating the comparison between production situations (6.5), we found that even though ETO companies had a slightly lower purchasing sophistication than non-ETO companies, the difference from non-ETO companies were not significant. Hence, we concluded that an ETO company does not have a lower sophistication compared to non-ETO companies.

In a closer investigation of the purchasing sophistication of ETO companies, we found the ETO companies' average scores on the six characteristics of purchasing sophistication. These are summarized in Table 50.

MEAN SOPHISTICATION OF ETO COMPANIES			
Indicator of purchasing sophistication	Mean*	σ (Std. deviation)	σ^2 (Variance)
Reporting to top management	4,29	0,694	0,482
Contribution to competitive position	4,08	0,818	0,669
Orientation on clerical duties (recoded)	2,82	0,926	0,857
Orientation on collaboration	3,79	0,741	0,549
Skills for cross-functional teams	3,53	0,830	0,688
Skills for developing strategies	3,29	0,802	0,644
Sample Size (N=)	38	*5 = Strongly agree, 1 = Strongly disagree	

Table 50: Mean sophistication of ETO companies

Considering these findings in relation to the three identified factors of purchasing sophistication (8.2.1), we recognize that the scores of the indicators constituting each factor are similar. More

specifically, we discover that the position of purchasing (reporting to top management and contribution to competitive position) within ETO companies is high. This indicates that purchasing is recognized in most ETO companies as being an important resource to the firm and has a high position within the company (Table 21).

In relation to our second factor of purchasing sophistication, skills of purchasing professionals (skills for participating in cross-functional teams and for developing strategies), we discover that these indicators score slightly above average. Comparing the indicators of this factor, we recognize that the skills to participate in cross-functional teams are somewhat higher than skills for developing strategies.

The third factor of purchasing sophistication, the nature of purchasing activities (orientation of clerical duties), has the lowest score. This may suggest that purchasing personnel in ETO companies are mostly concerned with clerical tasks and solving problems with suppliers. These findings are in accordance with identified theory, which states that purchasing in ETO companies is of a reactive, rather than pro-active, nature (5.4). It is important to note, however, that the score on the third factor has the highest standard deviation and variance; as such, it varies considerably between ETO companies.

Not included in any of the factors, is the characteristic of orientation on collaboration (Table 21), which has one of the highest average scores, implying that ETO companies may have several collaborative supplier relationships. This finding is not in accordance with ETO theory, that state that ETO companies are utilizing adversarial trading approaches (Hicks, et al., 2000; 5.4).

In summary, the results from Table 50 show that ETO companies appreciate the value of purchasing. This is somewhat contradictory, however, to the identified significant lower purchasing-to-turnover ratio (employed as a measure of purchasing's importance) of ETO companies compared to non-ETO companies. From this, we argue that the measure of purchasing-to-turnover ratio may be a poor indicator of purchasing's importance. However, we also acknowledge that the revealed score on position of purchasing from the survey, may be overrated by respondents. However, potential for improvements are found in the second and the third factor of purchasing sophistication. Hence, we argue that in order to achieve a higher level of purchasing sophistication, Norwegian ETO companies must change their reactive purchasing practice towards a more strategic and pro-active practice. In addition, for achieving higher sophistication, the purchasers' skills must be improved.

10.2 Findings from action research

In this section, we utilize our findings from action research and identified theory to assess the purchasing sophistication of ETO companies. This is done in two steps. First, we use our refined framework (Figure 47) as a basis for an evaluation of ETO companies with regards to the development model by van Weele (2010). Second, the refined framework serves as the basis for a second evaluation of the purchasing sophistication of ETO companies, now using the identified characteristics of purchasing sophistication (Table 21). Finally, we summarize the two

classifications and propose which is the most appropriate for measuring the purchasing sophistication of ETO companies.

10.2.1 ETO companies in van Weele's (2010) development model

When comparing purchasing sophistication characteristics with a purchasing development model (4.3.2.), we argued that the different stages in the development model by van Weele (2010) reflect different levels of purchasing sophistication. As such, a development model may possibly be used to assess a company's level of purchasing sophistication.

The development model by van Weele (2010) seems to be developed on a general level – for purchasing functions in all kinds of companies (4.2). Van Weele (2010) does, however, place various industries in his maturity model (4.2.1; Figure 27). We here seek to assess how the ETO production situation, rather than an industry, relates to the model.

Using the refined framework of ETO (Figure 47), we see that purchasing practice in ETO companies comprise elements from various stages in the development by van Weele (2010). First, we know that purchasing is rather clerical, and that purchasing is done reactively in ETO companies (5.4). These are both elements of stage 1 in the model of van Weele (2010). Further, from stage 2 in the model, one recognizes the low cost focus of purchasing identified in theory (5.4). Action research findings, however, showed that the low cost focus not necessarily is evident for all ETO companies – they may also have a focus on e.g. quality and communication when sourcing (Figure 47). Taking other aspects than price into account when sourcing, like the ones mentioned; is a characteristic of stage 3 in the development model (4.2.1). Also, from the same stage, utilizing buyer power through coordination between business units towards smaller suppliers is recognized (Figure 47). In stage 3, however, the purchasing function should have a focus on cross-functional collaboration and a formulation of purchasing strategy (4.2.1). These elements have not been recognized to be evident in either theory or empirical findings, indicating that ETO companies may be below stage three in the model. Further, purchasing portfolio analysis is said to be used in this stage; and survey findings showed that 47,1% (Table 48) of the sample's ETO companies are actually using this.

Further, from stage 4 we recognize a move from confrontational sourcing, to partnership sourcing, as suppliers are included in problem solving activities (4.2.1). From action research, we found that relationships in ETO companies may be characterized as built on continuity and trust; however the suppliers were not included in problem solving (Figure 47). Theory on ETO companies claim that adversarial trading approaches are prevalent in purchasing practice (5.4). As such, we argue that ETO companies may have characteristics of both stage 3 and 4 in relation to supplier relationships. Finally, from stage 5, we recognize the use of outsourcing (Figure 47). From this discussion, we see that ETO companies may comprise elements from five different stages in the development model by van Weele (2010), as depicted below.

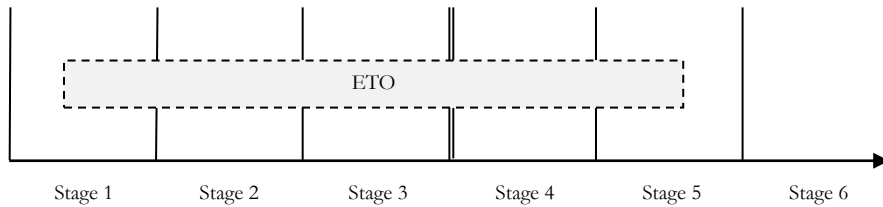


Figure 52: Purchasing sophistication of an ETO company

Through utilizing the development model by van Weele (2010) in practice, we have identified that an ETO company’s purchasing practice not necessarily falls under one stage. Rather, an ETO company’s purchasing function may constitute a potential *unique* compilation of practices and characteristics. As such, we argue that the different stages in van Weele’s (2010) model not are mutually exclusive, but that they may overlap each other. We thus argue that discretion should be exercised when classifying ETO companies in the model. This finding indicates that further empirical testing of the development model is needed – to verify whether it really can describe different purchasing functions in a step-wise manner. However, we argue that is of value to establish such a development model, as it is a diagnostic tool for evaluating a company’s purchasing sophistication.

10.2.2 ETO companies and purchasing sophistication characteristics

Having established that the development model by van Weele (2010) is somewhat vague in determining the sophistication of a purchasing function, we now utilize the six characteristics of purchasing sophistication developed by Gelderman and van Weele (2005; Table 21) for assessing ETO companies’ purchasing sophistication. The refined framework of ETO (Figure 47) serves as the basis for the following classification.

Regarding the first characteristic of purchasing sophistication, *reporting level*, we see that both theory and empirical findings indicate a low sophistication. First, theory state that purchasing is clerical and rather operational (5.4), making it natural to assume that the reporting length to top management is long. Hence, we argue that the reporting level of ETO companies can be characterized as low.

The second characteristic of purchasing sophistication, *contribution to competitive position*, is regarded low in identified ETO theory. This is argued due to the literature’s description of ETO purchasing as reactive and clerical (5.4). In the action research, we found no evidence of opinions regarding purchasing as a competitive contributor. Hence, we argue that the view of purchasing as a competitive contributor in ETO companies is low.

The third factor, *orientation on collaboration*, is also implicitly regarded as low in ETO theory, as approaches toward suppliers are described as adversarial (5.4). Action research, however, found that adversarial trading approaches not were evident, and that some of the relationships were characterized by trust and continuity (Figure 47). However, we found no indication of the buyer

company having any collaborative initiative towards their suppliers, even though the supplier relation was characterized as friendly. This low orientation on collaboration coincides with the theory mentioned above, making us confident in classifying the orientation on collaboration as low in ETO companies.

The characteristic of *skills to participate in cross functional teams* is not addressed in ETO theory, even though it is identified as a need for ETO companies (5.3). In the action research, we found that the problem holder was not accustomed to working in cross-functional teams, as they did not see the need for it (7.3.1). As such, they had little training for such collaboration. A finding that describes this well, is the observation of a participant remaining silent through a longer period of time, when “his component” or areas of specialization was not the topic of discussion (PPA_Observation_2). As such, we argue that, due to lack of training, the skills to participate in cross functional-teams are low.

ETO theory does not address the fifth characteristic of purchasing sophistication, *skills for developing strategies*. As for the action research, we found that the participants were not accustomed to developing formalized strategies; rather, they divided the areas of responsibility between three purchasers (7.3.1). It is an interesting finding that the participants in the second workshop actually preferred a purchasing portfolio approach that gave them an explicit strategy, in spite of a purchasing portfolio approach where they themselves had to develop strategies (8.1.2). As such, we argue that the skills for developing strategies are low, due to a lack of interest and experience in such an activity.

The last characteristic, *orientation on clerical duties*, is mentioned in ETO theory in that the purchasing practice is said to be reactive and non-strategic (5.4). Considering today’s purchasing practice of the problem holder (7.3.2), we discover that the ETO company has few contractual agreements and no collaboration with any of their suppliers. As such, we argue that this observation coincides with theory. Hence, we argue that this characteristic of purchasing sophistication of ETO companies also is low.

From the aforementioned discussion, we can further evaluate the three dimensions of purchasing sophistication (8.2.1) in relation to an ETO company. The first factor, *position of purchasing*, may be regarded low, as both the underlying factors of reporting level and contribution to competitive position are classified as low. The second factor, *skills of purchasing professionals*, can be classified as low, as skills of participating in cross-functional teams are low; and the third factor, *position of purchasing*, may be classified as low due to the characteristic of orientation on clerical duties is considered low.

In summary, we have found that all characteristics of purchasing sophistication are regarded as low in ETO companies. As such, it is plausible to state the purchasing sophistication of purchasing in total is low for an ETO company.

10.2.3 Evaluating purchasing sophistication

Having employed both a development model and characteristics of purchasing sophistication for evaluating a company’s purchasing sophistication, we found that the development model

may be too vague in determining a distinct level of purchasing sophistication. However, we acknowledge the value of the model, in that it provides a more nuanced description of a company's level of purchasing sophistication, compared to the characteristics, which are either classified as high, medium or low.

10.3 Conclusion

In this chapter, we have investigated the link between the ETO production situation and purchasing sophistication. Survey findings revealed that purchasing's position in ETO companies is regarded as high. However, we proposed that there is potential for improvement regarding the two remaining factors of purchasing sophistication; the nature of purchasing activities and the skills of the purchasing professionals.

Using our refined framework (Figure 47), we evaluated the purchasing sophistication of an ETO company, both by employing the development model by van Weele (2010) and the characteristics of purchasing sophistication (Gelderman and van Weele, 2005). We argued that the development model by van Weele (2010) was too vague in determining the level of purchasing sophistication of an ETO company, as we found that a company may possess elements from various stages in the development model. However, the six characteristics of purchasing sophistication (Gelderman and van Weele, 2005) revealed that ETO companies can be classified as having low purchasing sophistication. Consequently, by characterizing the purchasing sophistication of ETO companies, explaining *how* and *why* ETO companies are classified to have a low purchasing sophistication, we have answered our third research question.

11 Purchasing portfolio approaches and ETO

The intention of this chapter is to evaluate the link between purchasing portfolio approaches and the engineer-to-order production situation, and as such, provide an answer to our fourth research question; *how can a purchasing portfolio approach be adapted to, and used by, an ETO company with similar characteristics as Fugro?* This research question is answered mainly on the basis of action research; however, survey findings will be utilized to support our inferences and conclusions. We will draw on discussions made in chapter 8, concerning the topics of purchasing portfolio approaches (8.1) and engineer-to-order (8.3), and discuss how these are coupled. We will also utilize empirical findings that are postponed to this chapter.

In the first section, we use survey research findings to motivate why an ETO company with similar characteristics as Fugro should use a purchasing portfolio approach. In the next section, we analyze action research findings in order to establish whether power and dependence conditions in ETO companies differ from what is identified in literature. Thereafter, we discuss the ETO adapted portfolio model that was developed in the specialization project. In the third section, we recommend a purchasing portfolio approach for ETO companies with similar characteristics as Fugro. Here, we also point to adaptations of the suggested purchasing portfolio approach, and provide practical guidelines for its use. In the final section, we conclude this chapter by answering RQ4.

11.1 Findings from survey research

From our investigation of the link between using a purchasing portfolio approach and a company's level of purchasing sophistication (9.1), we established a connection between using a purchasing portfolio analysis and the skills of the purchasing professionals. Further, we implied a direction on this connection, stating that the use of a purchasing portfolio approach facilitates the development of skills (9.1.1).

When investigating the link between purchasing sophistication and engineer-to-order companies, it was discovered from survey research findings that the skills of the purchasing professionals had a potential for improvement (10.1.1). As such, we establish that ETO companies would benefit from using a purchasing portfolio approach, as it may facilitate the development of skills pertaining to the purchasing professionals and in turn increase the companies' level of purchasing sophistication. In the section, we discuss action research findings with respect to the linkage between purchasing portfolio approaches and ETO.

11.2 Findings from action research

In this section, we discuss the action research findings with respect to the linkage between purchasing portfolio approaches and ETO. We first investigate whether power and dependence conditions in ETO companies differ from what is identified in literature. Thereafter, we discuss and discard the ETO adapted portfolio model that was developed in the specialization project by virtue of action research findings (cf. 1.2; Figure 10).

11.2.1 Power and dependence

In this subsection, we investigate to which extent the concepts of power and dependence are prevalent in practice, compared to what is identified in theory on purchasing portfolio approaches (3.6). This is done through determining the relative power of the supplier relationship, for a selection of the components investigated in our action research. First, we present the selection of components, before discussing the distribution of power in these supplier relationships in the succeeding paragraphs. We conclude this subsection by discussing the impact of the discovered occurrence of power and dependence on purchasing portfolio approaches.

Components subject to analysis

In our action research, we applied and introduced a total of three purchasing portfolio approaches. However, in order to make comparisons with identified theory on the subject of power and dependence in purchasing portfolio approaches (3.6) we only utilize the findings from the testing of the Kraljic matrix, as this is the only model previously tested empirically in relation to buyer power (Caniëls and Gelderman, 2007; 3.6.2). Furthermore, when placing the different products in the Kraljic matrix, we discovered some discrepancies in classifications between the two workshops (7.3.1). In order to investigate the concept of power and dependence, we therefore see it beneficial to closer investigate those components which were placed in the same quadrant in both workshops, as we argue that these components are “correctly” classified. Consequently, our investigation of power and dependence is limited to the following components; lithium batteries³¹, lead batteries and shell.

Lithium batteries

In our action research, the workshop participants were encouraged to place the battery pack component within the Kraljic matrix (7.3.1). However, it became apparent during the process that this battery pack consisted of both lead and lithium batteries (7.3.1). Hence, we see it beneficial to separate the battery pack in two components, lead and lithium batteries, as each type has its distinct sourcing practice and the two types are bought separately. In this paragraph, we provide the analysis of the practice on sourcing the lithium battery, before presenting a similar discussion on lead batteries in the next paragraph.

Referring to our mapping of today’s practice (7.3.2), the lithium batteries are supplied from a single French supplier, which is one of the world’s largest manufacturers of this type of product. Hence, it is obvious that Fugro is a much smaller company in relation to this supplier, and though their purchase of lithium batteries may constitute a major cost, we argue that this financial magnitude is small for the supplier. Using the determinants of buyer’s and supplier’s dependence, depicted in Table 18, we suggest that this argumentation shows that the supplier may possess a favorable power position.

Further, these batteries are made especially for Fugro, (which entails that the supplier cannot sell these lithium battery cells to its other customers) (7.3.1); hence, the supplier will lose its market

³¹ In the first workshop, the battery pack was placed in the matrix, based only on the discussion of the lithium battery, as such the two workshops agree on the placement of this component.

of this type of lithium battery cell if he terminates the relationship with Fugro. As such, the supplier has a high switching cost and no alternative buyers, which according to the determinants of buyer's and supplier's dependence (Table 18), generates power for the buying firm. However, this applies equally for Fugro, as this is the only supplier who can make the lithium batteries in accordance with Fugro's important safety requirements (7.3.2). Hence, Fugro are equally interested in preserving the relationship as the French supplier; as such the power is balanced in respect to switching cost and availability of other supplier/buyers (Table 18). Then again, the French supplier is not as dependent on Fugro's technological expertise as Fugro are of this supplier; hence the balance of power is shifted towards the supplier in relation to this variable.

In summary, our knowledge of the supplier relationship towards the French supplier suggests that the overall buyer's dependence on the supplier is relatively larger than the supplier's dependence on the buyer. Consequently, according to the determinants of buyer's and supplier's dependence (Table 18), we argue that the relative power in relation with the supplier of the lithium batteries is in favor of the supplier.

Lead batteries

The lead batteries are supplied from a local wholesaler, which is committed to keep a certain stock of these components (7.3.2). As Fugro do not have any contractual agreements with this supplier, the commitment of keeping stock shows that the supplier is willing to incur inventory cost to maintain a relationship with Fugro. Hence, we argue that this indicates that the overall dependence of the supplier (Table 18) on the buyer (Fugro) is higher than vice versa. Consequently, in relation to this indicator of dependence, Fugro have the power advantage over the supplier. This is further supported by the fact that this supplier is a wholesaler; and as such, we argue that Fugro is not dependent on the supplier's technological expertise (Table 18). For instance, Fugro can circumvent the wholesaler and approach the supplier's suppliers directly, if necessary. Further, it was stated that there were several suppliers which could provide the same component, which indicates a high availability of alternative suppliers (7.3.1) and a power advantage in the relationship toward the supplier.

When evaluating the lead battery in relation to applying the Kraljic matrix, no additional information, in relation to the other the determinants of buyer's and supplier's dependence (Table 18), was found. However, we argue that we have enough information to conclude that the relative power in relation with the supplier of the lead batteries is in favor of Fugro. Next, we analyze the balance of power in the relationship towards the supplier of shells.

Shell

Fugro are currently using a single supplier of the buoy's shells, which is committed through contractual agreements to keep a certain stock of these components (7.3.2). We learned that Fugro are the only customer of these components, implying that the supplier does not have any available alternative buyers (Table 18), increasing the supplier's dependence on the buyer. However, we argue that this argumentation also applies the other way around; Fugro do not have any other available suppliers capable of providing this component. This reasoning is based

on the fact that the employed supplier is the only Norwegian supplier capable of performing the required rotational casting process (7.3.2). Even though they are currently in the process of finding alternative suppliers (7.3.2), we learned that it takes about six months to go from prototyping to series production with a new supplier. Consequently, in addition to having few alternative suppliers, the costs of switching suppliers are significant. Further, the need for the supplier’s technological expertise is apparent. As such, the supplier has a considerable power advantage over Fugro. However, as this single supplier delivers to other subsidiaries of the Fugro Group, a framework agreement have been negotiated with the supplier (7.3.2). Nonetheless, we argue that this does not change the interdependencies noteworthy. Consequently, the relative power with the supplier of lead batteries is in favor of the supplier.

In the next paragraph, we summarize the above discussion and further relate it to theory.

Comparisons

Caniëls and Gelderman (2007) observed different power characteristics in buyer-supplier relationships in the different product categories of the Kraljic matrix (3.6.2). They found, for instance, that relationships in the strategic and bottleneck quadrants are characterized by supplier dominance, whereas relationships in the non-critical quadrant are characterized by buyer dominance. Table 51 below seeks to compare the discovered relative power characteristics in each supplier relationship, related to the investigated components in action research, and what we could expect based on the observations done by Caniëls and Gelderman (2007).

RELATIVE POWER OF THE SELECTED COMPONENTS			
Component	Placement in the workshops	Relative power	
		Observed (Caniëls and Gelderman, 2007)	Results from workshop analysis
Lithium batteries	Strategic	Supplier dominance	Supplier dominance
Lead batteries	Non-critical	Buyer dominance	Buyer dominance
Shell	Bottleneck	Supplier dominance	Supplier dominance

Table 51: Relative power of selected components

What is evident from Table 51, is that our discovered relative power characteristics in relation to the selected components coincide with the findings by Caniëls and Gelderman (2007) (3.6.2). As such, we support their findings, and suggest that an ETO company, with similar characteristics as Fugro, may have a similar distribution of relative power in their supplier relationships as companies in other production situations. Further, we see that components with a higher supply risk are characterized by supplier dominance, which coincides with the statement made by Caniëls and Gelderman (2005), who relate the concept of power to purchasing portfolio models (3.6.2). We argue that these findings support the argument by Dubois and Pedersen (2002), in that differences in power and dependence between buyer and suppliers seem to be a fundamental assumption behind purchasing portfolio models (3.6).

In relation to the component positioned within the strategic quadrant (Table 51), we see that both the analysis of the action research findings and theory (3.6.2) indicate that the supplier has the relative power in these buyer-supplier relationships. Further, one could argue that the buyer should avoid such supplier dominated, strategic relationships. However, as learned in action research, a smaller company may be dependent of such relationships as the strategic supplier provides the highest quality (ETO_Observation_20). Consequently, we argue that this should be reflected in the generic strategies provided for this quadrant. Recapitulating theory (3.4.1), we see that the strategic quadrant of the purchasing portfolio model used in the action research (Figure 22) is limited to using the “balance strategy” provided by Kraljic (1983) for strategic products (3.4.1). However, based on the identified prevalence of supplier dominance in these types of relationships, we argue that it may not be feasible to apply the balance strategy, as it recommends the establishment of strategic relationships. We argue that a more beneficial strategy to adopt for the strategic quadrant is the “diversify” strategy (3.4.1) proposed by Kraljic (1983) for supplier dominated relationships in the strategic quadrant. This strategy implies that the company has to take a defensive position, and search for alternative suppliers or substitute items. In this category, the company can, according to Kraljic (1983), consider the option of backward integrating if there is a shortage on suitable suppliers.

For the non-critical and bottleneck items, the relative power was as expected, based on the recommended strategies provided by the further developed Kraljic matrix (Figure 22). Hence, we see no need to make adaptations in relation to power and dependence in these strategies. In summary, our analysis shows that the concepts of power and dependence are as prevalent in connection to purchasing portfolio approaches as identified in theory. In addition, we argue that the strategies recommended by the purchasing portfolio approaches should incorporate a concern for relative power. As an example, the Kraljic matrix’s strategic quadrant should be limited to the diversify strategy from the approach by Kraljic (1983), as the supplier has more power in this quadrant. We acknowledge that power and dependence may change over time; however, we argue that longitudinal studies are needed to establish its effect on generic strategies and the positioning of the components in the matrix. In the next subsection, we evaluate and discard the ETO adapted portfolio model made by the authors in fall 2011.

11.2.2 Discarding the ETO adapted portfolio model

In our specialization project, we proposed an ETO adapted purchasing portfolio model (1.1.6; Figure 7). As depicted in Figure 10 (1.2), this model was tested in this master’s thesis, through conducting action research. In the workshops with Fugro, the participants were asked to evaluate both the value and challenges associated with the proposed portfolio model (7.4.2). The perceived value of the model was that it did not emphasize the volume of purchases as much as the other approaches did; as such, it was regarded as more suitable for Fugro. The workshops participants also regarded the model’s dimensions (degree of customization and relative power (1.1.6)) to be easy to relate to, which eased the positioning of the components in the model (7.4.2). While being easy to relate to, the nature of the dimensions were also regarded as a challenge: In general, does the customization dimension refer to a product that is company standard and repeatedly manufactured by a supplier, or does it refer to a one-of-a-kind product made to order? In more detail, three scenarios describing challenges concerning the degree of

customization dimension were identified in action research: a component may be customized in the eyes of the customer, even though sub-components are standard products; a component may be customized in terms of being specified to the customer, and still have a standardized production process; and, a component may be standard in the eyes of the customer, and customer specific in the eyes of the supplier (PPA_ETO_Observation_1; 2; 3, respectively). In addition, one of the participants was reluctant to address relative power at all, in saying that power is not a thing you think of to start with, “it is something you experience” (7.6).

In retrospect, we also acknowledge that degree of customization may be an underlying factor of relative power. For instance, if a customized product is a component that is specifically manufactured repeatedly for the customer, the supplier may have a hold-up problem; i.e., if the supplier has invested in equipment to make products according to specifications, he is dependent upon the buyer. As such, the buyer has increased relative power over the supplier. On the other hand, if the customized product is a one-of-a-kind product made to order, the supplier may be the only available supplier with sufficient capabilities to make such a product; implying an increased relative power over the buyer. This is supported by the final positioning of the products in the ETO adapted model (Figure 42), where we see that most of the components positioned by the first workshop are located at a diagonal in the matrix. This tendency in the positions reflects the reasoning above. As such, we suspect that the model distinguishes products along only one dimension, and hence is not working as intended; distinguishing products along two dimensions.

In summary, we identified challenges related to the two dimensions of the ETO adapted portfolio model which undermined purchasing portfolio approaches’ purpose of balancing a portfolio of relationships (8.1.3). However, it preserved its intention of organizing information and facilitating communication (8.1.3). We choose to discard the ETO adapted portfolio model for further use, because we feel that we are able to recommend an existing approach that is able to attend to all identified main purpose of using a purchasing portfolio approach (8.1.3). This is the subject for the next section.

11.3 Proposing a purchasing portfolio approach

Earlier in this chapter (11.1), we established that using a portfolio approach is beneficial, as it may facilitate the development of purchasing professionals’ skills, and as such, the level of purchasing sophistication. Hence, in this section we seek to propose a suitable purchasing portfolio approach for ETO companies with similar characteristics as Fugro. First, we elaborate on the established benefit of using purchasing portfolio approaches with action research findings. Thereafter, we use the segmentation model (Figure 51) developed in chapter 9, in order to derive a recommendation for which purchasing portfolio approach to use. Finally, we provide adaptations of the selected approach, together with guidelines for use and implementation of it.

11.3.1 Motivating the use of purchasing portfolio approaches in ETO companies

In addition to the mention benefits of using purchasing portfolio approaches (11.1), we discovered through action research that the use of purchasing portfolio approaches also may: (1)

Enable pro-active sourcing, through making differentiated sourcing strategies, (2) facilitate communication, (3) formalize purchasing practice, and (4) codify tacit knowledge. These benefits of using a purchasing portfolio approach is especially relevant for ETO companies due to the identified reactive purchasing practice and need for cross-functional integration (Figure 47). In this way, we see the need for the use of purchasing portfolio approaches in ETO companies, as proven by both survey - and action research. Next, we propose a suitable purchasing portfolio approach for ETO companies with similar characteristics as Fugro.

11.3.2 Proposing a purchasing portfolio approach for an ETO company

In order to propose a purchasing portfolio approach for an ETO company with similar characteristics as Fugro, we see it beneficial to utilize our segmentation model developed in chapter 9 (Figure 51). For being able to use this model, we have to assess the level of purchasing sophistication in relation to the characteristics of orientation on collaboration and skills for developing sourcing strategies. Hence, we utilize our findings from chapter 10, which assessed the relative purchasing sophistication of ETO companies. We rely on the action research findings, as these more descriptive due their qualitative nature.

First, when regarding the *orientation on collaboration* of ETO companies with similar characteristics as Fugro, we found that adversarial trading approaches not were evident; rather, trust and continuity characterized some of the relationships (Figure 47). However, we found no indication of the buyer company having any collaborative initiative towards their suppliers, despite the “friendships” between the companies. As such, we see that it is possible with relationships towards the supplier built on trust and continuity, without having an orientation on collaboration. Hence, we argue that ETO companies, similar to Fugro, have a low orientation on collaboration.

In relation to *skills for developing strategies*, we discovered in our action research that the participants were not accustomed to developing sourcing strategies. In addition, the participants in the second workshop preferred a purchasing portfolio approach that gave them an explicit strategy, in contrast to a purchasing portfolio approach where they themselves had to develop strategies. Hence, we argue that the skills for developing strategies are low in companies similar to Fugro.

Having classified both dimensions of the segmentation model as low, we see it natural to propose that ETO companies with similar characteristics as Fugro should adopt the purchasing portfolio approach suggested by van Weele (2010), as the segmentation model propose this approach for such a level of sophistication - illustrated in Figure 53.

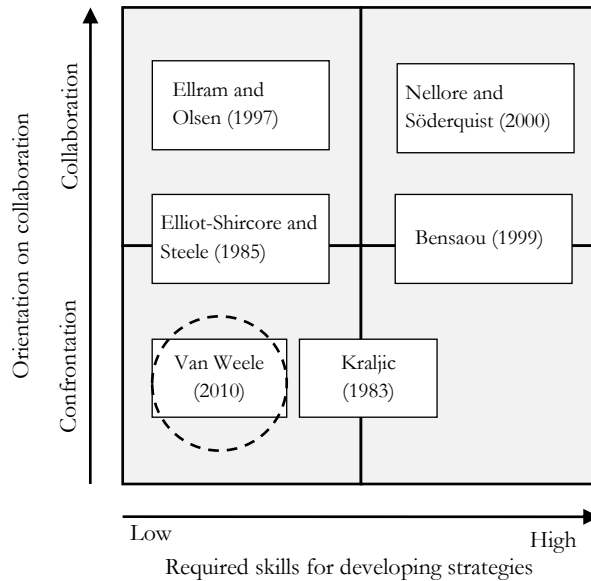


Figure 53: Proposed purchasing portfolio approach for ETO companies with similar characteristics as Fugro

As such, by recommending the approach by van Weele (2010), we have taken the characteristics of the ETO production situation into account. In contrast to our suggested ETO adapted portfolio model from the specialization project, we argue that the approach by van Weele maintains all the identified purposes approach, including the purpose of balancing the portfolio of relationships. This is due to the fact that this approach is built upon the model of Kraljic (1983), which we empirically tested in action research, and found to be able to separate the components along two dimensions – to a greater extent than the proposed ETO adapted model.

11.3.3 Adaptions to the ETO production situation

Having proposed the use of the van Weele approach (2010) for ETO companies, we argue that it is beneficial to do some minor adaptations of the approach to further tailor the approach to the ETO production situation.

It was identified above (11.2.1) that power characteristics are prevalent in the supplier relationships in ETO companies. In the same section we suggested an adaption of the Kraljic (1983) in order attend to the revealed power characteristics. We argue that the approach by van Weele (2010) has to be adapted in a similar manner, for addressing the same power characteristics. This implies limiting the recommended generic strategies in the strategic quadrant to the supplier dominated segment (3.4.2); hence proposing a defensive position and search for new suppliers. Our action research findings supports this adaption, as Fugro indeed found it hard to establish collaborations with suppliers in this quadrant (ETO_Observation_15),

making the strategy non-feasible. Next, we present some practical guidelines for implementation and use of the recommended purchasing portfolio approach.

11.3.4 Practical guidelines

From conducting action research, we gained valuable experience in terms of using a purchasing portfolio approach. As such, we present some practical guidelines for the use of a purchasing portfolio approach in an ETO company.

First, we found it valuable to *address each of the measures systematically* in order to reap as much relevant information about the component as possible, and making sure that no measure was forgotten (PPA_Observation_13). We saw evidence of components being placed differently after new information from measures occurred (PPA_observation_3). As such, we argue that to get a correct placement of the component, and as such avoid misallocation of resources, all relevant measures should be taken into consideration.

Second, we argue that it must be explicitly stated that the name of each quadrant and dimension not are measures in themselves; it should be the underlying measures of the dimensions that should be addressed. For instance, as discussed in 8.1.2, the name of the quadrants may lead to pre-dispositions of the component (PPA_Observation_5), downplaying the various measures of the dimensions. Further, an initial evaluation of the dimension alone may be altered as the underlying measures are considered (PPA_Observation_8). Hence, we argue that *it should be explicitly stated that the names of the quadrants and dimensions not are measures themselves*.

Third, when conducting action research, we saw it valuable to *have employees from different organizational functions participating in the process* (PPA_Observation_7). We argue that this is important for providing more information on each component, and achieving a more balanced view of components and hence a better subsequent classification. We argue that use of an external facilitator of the process may be beneficial, in order to involve all participants in this context, as we found that some practitioners remain passive when classifying a component that was not his area of responsibility (PPA_Observation_2).

Fourth, *the arena and process of using a PPA should stimulate discussion, formalization of practice, and codification of tacit knowledge* (PPA_Observation_21). We argue that one should not rush through the process of using a purchasing portfolio approach for merely getting an output from the model itself, but rather facilitate a good process, as there is much value in this (PPA_Observation_21).

Fifth, for ETO companies specifically, *make sure that you are talking about the same component*. We found that using PPA for components that actually are modules are challenging due to the complex product structure (PPA_Observation_4; PPA_Observation_6; PPA_Observation_11; PPA_Observation_12). The practitioners should themselves decide whether it is the module as a whole, or the sub-components that is to be classified in the model.

Finally, *time, resources and a dedicated person should be assigned to implementing PPA*, as lack of time, resources, and designation may impede the implementation of such an approach (PPA_Observation_18; 19; 20).

This concludes our proposed guidelines for using the proposed purchasing portfolio approach. Next, a conclusion is provided, answering the fourth research question.

11.4 Conclusion

In this chapter, we have investigated the link between the ETO production situation and the use of purchasing portfolio approaches, with the intention of answering our fourth research question. A motivation for the need of using purchasing portfolio approaches in ETO companies was given with the use of findings from both survey – and action research. We investigated the prevalence of power and dependence in buyer-supplier relationships, which revealed that identified power and dependence characteristics, coincides with identified theory. Further, on the basis of action research, we discarded the proposed ETO adapted model from the specialization project, as it was revealed that it did not possess all the identified purposes of using a purchasing portfolio approach. Hence, we argued that there are other, more advantageous purchasing portfolio approaches. From this, we utilized the developed segmentation model (Figure 51), in order to propose a more suitable purchasing portfolio approach for ETO companies with similar characteristics as Fugro. The approach by van Weele (2010) was proposed, on the basis of the established low sophistication of ETO companies. Minor adaptations of the approach were proposed, in order to attend to the identified power and dependence characteristics of buyer-supplier relationships. Finally, by the virtue of our action research, we were able to give six guidelines for implementation and use of purchasing portfolio approaches in ETO companies with similar characteristics as Fugro. As such, we have answered our fourth research question in an elaborate manner.

Part IV: Conclusions and implications

In this part, we present our conclusions and implications derived from our research. First, we present our answers to each of the thesis' research questions, before providing an answer to the overall problem formulation. Second, we present the major limitations of our research, and suggest areas for further research related to these. Finally, implications for relevant stakeholders are given.

12 Conclusions

In order to conclude on our findings, we take our four research questions as a point of departure; we repeat them and give explicit answers to them based on previous discussions. Finally, to sum up, our problem formulation is discussed.

RQ1: What are important features of purchasing portfolio approaches, purchasing sophistication and engineer-to-order?

The first research question was answered by constructing a theoretical framework in the first part of this master's thesis (theoretical foundation), and further refining it at the outset of the analysis by including empirical findings from both survey - and action research. Here, we summarize important features of purchasing portfolio approaches, purchasing sophistication and engineer-to-order, respectively.

Purchasing portfolio approaches

The context of using a purchasing portfolio approach is the development of sourcing strategies, i.e. decision processes used to identify which suppliers, form of contract and performance measures that should be employed for a category of sourced products. As such, three main identified purposes of using a purchasing portfolio approach are: (1) balancing the portfolio of relationships; (2) organization of information; and, (3) facilitation of communication. Our survey research revealed, inter alia, that 47.1% of the responding companies use purchasing portfolio approaches, and that there is a statistically significant relationship between the use of PPA and: having a sourcing strategy; having a purchasing department; and, company size.

Comparison between the most prevalent purchasing portfolio approaches (Kraljic, 1983; Elliot-Shircore and Steele, 1985; Olsen and Ellram, 1997; Bensaou, 1999; Nellore and Söderquist, 2000; van Weele, 2010) revealed that they differ with respect to their contribution and main characteristics, including their utilization of buyer power, number of stages, having a buyer's perspective and their development in relation to each other. Here, our action research indicated that a more elaborate approach may be easier to use than a perceived simpler one, as it breaks down the complexity of the sourcing situation through extensive guidance. Further, identified critique of purchasing portfolio approaches can be divided in four groups, concerning: the position of the products; the models' dimensions; relationships and the supplier's perspective; and, purchasing's strategic recognition. Finally, our action research revealed operational challenges concerning predispositions caused by the quadrants in the models' names, difficulty of positioning modular components and the use of an external facilitator when conducting purchasing portfolio analysis. These operational challenges were not identified in literature; hence, they expanded our theoretical framework.

Purchasing sophistication

Our chosen definition of the concept states that purchasing sophistication determines to a great extent purchasing's role and integration into the strategic management decision making process (Pearson and Gritzmacher, 1990). However, the identified literature indicates that the closely related concept of purchasing professionalism and maturity are used interchangeably with

purchasing sophistication. In order to achieve a more elaborate understanding of the concept, we have adopted six characteristics of purchasing sophistication, provided by Gelderman and van Weele (2005): (1) reporting level; (2) contribution to competitive position; (3) orientation on collaboration; (4) cross-functional teams; (5) developing strategies; and (6) (non-)clerical activities. This enabled us to measure purchasing sophistication as a multiple item construct in our survey research. In turn, an exploratory factor analysis of the survey research data suggested that purchasing sophistication is in fact a three-dimensional construct. The first factor (“purchasing position”) was also found by Gelderman and van Weele (2005) in a similar study. This factor includes the first and second characteristic of purchasing sophistication. Further, we found a second factor (“skills of purchasing professionals”) that includes the fourth and fifth characteristic. Our third factor (“nature of purchasing activities”) included the sixth characteristic of purchasing sophistication; clerical activities. The third characteristic (orientation on collaboration) cross-loaded on the first and third factor, and consequently, it was excluded from our factors of purchasing sophistication.

Further, our survey research findings found a statistically significant relationships between: having a sourcing strategy and the level of purchasing sophistication; using purchasing portfolio analysis and skills of the purchasing professionals (second factor of sophistication); and having a purchasing department and skills of the purchasing professionals. In addition, it was identified in literature that several characteristics of purchasing sophistication have been derived from purchasing development models. As such, we were keen on testing whether a development model displays increasing levels of purchasing sophistication, when evolving through increasing stages of development. We found, using the adopted characteristics of purchasing sophistication, that the level of purchasing sophistication is, in fact, increasing with the stage evolution. As such, we also rejected some of the critique of purchasing development model; that such models do not necessarily reflect an increasing level of sophistication. Finally, we identified that companies are prone to a minimum maturity point, under which the implementation of best practice defeat its own ends.

Engineer-to-order

We found that literature on the engineer-to-order (ETO) production situation allegedly is sparse compared to that of the high-volume production situation. Many authors have tried to classify production situations like ETO with different taxonomies and terminologies, often using the concept of customer order decoupling point (CODP) as the point of departure. It is concluded that no consensus have been made in the literature regarding terminology, but there is an implicit agreement in the literature that, for an ETO company, the CODP lies at the design stage of a project. We argue that even though some components may be standardized, at least parts of the product are engineered-to-order; resulting in this position. This engineering component (one or several) distinguishes ETO from other production situations.

Theoretically identified characteristics of the ETO production situation are related to: products; processes; markets; risk and uncertainty; and, identified challenges. Here, action research findings supported the ETO products’ deep product structure. Further, we found that the product complexity is not limited to the product itself, but also in sourced components/systems.

Further, we verified that postponement may be used to deal with the identified challenge of change orders. Here, we refined the framework, by adding that communication across functions, facilitated by co-location, may also contribute to meet this challenge. A need for cross-functional integration was identified in theory, and subsequently refined through our action research. Here, we argued that cross-functional coordination may suffice for smaller companies, due to vague facets between functions and being co-located at the same premises. Finally, we discovered from our action research that the purchasing practice in a company with similar characteristics as Fugro somewhat deviates from the clerical, reactive, cost focused adversarial practice stipulated in theory. We found that some supplier relationships are characterized as “friendships”, displaying trust and continuity, and that bargaining power may be achieved by bundling volumes, possibly across subsidiaries.

RQ2: What is the relationship between purchasing sophistication and the use of purchasing portfolio approaches?

The second research question was answered by investigating how the use of purchasing portfolio approaches affect purchasing sophistication, and how purchasing sophistication characteristics relate to the purchasing portfolio approaches presented in this master’s thesis. First, the use of survey research established that the use of purchasing portfolio approaches may enhance the skills of purchasing professionals, which is one of three identified factors of purchasing sophistication. In detail, the use purchasing portfolio approaches enhances the skills of the purchasing professionals in terms of *skills to participate in cross-functional teams*, and in *developing strategies*, respectively.

Second, it is found that the use of purchasing portfolio approaches is significantly related to the variable of having a sourcing strategy. As having a sourcing strategy again is found to be significantly related to purchasing sophistication, this provides a connection between the use of purchasing portfolio approaches and the concept of purchasing sophistication as a whole.

Finally, the purchasing sophistication characteristics of *orientation on collaboration* and *skills to develop strategies* were found to enable segmentation between various purchasing portfolio approaches. From this, a segmentation model for purchasing portfolio approaches was proposed. Based on the logic of minimum maturity points, the segmentation model may contribute to help companies in choosing an appropriate purchasing portfolio approach, given their current level of purchasing sophistication. As such, the model depicts how the characteristics of purchasing sophistication relate to the prevalent purchasing portfolio approaches.

RQ3: How is purchasing sophistication reflected in the purchasing practice of ETO companies?

Our third research question was answered through evaluating ETO companies’ purchasing sophistication through both survey – and action research. ETO companies were evaluated with respect to the three identified factors of purchasing sophistication: *purchasing’s position*; *skills of purchasing professionals*; and *the nature of the purchasing activities*. Survey findings indicated that Norwegian ETO companies regard purchasing’s position in the organization as high, while viewing the skills of the purchasing professionals as average. The survey research further

showed that the orientation on clerical duties in Norwegian ETO companies' purchasing practice is high. As such, Norwegian ETO companies classify the underlying factors of purchasing sophistication with high variety – making it hard to establish one sole classification of the purchasing sophistication from this research method.

Through the combination of action research findings and identified theory, however, the purchasing sophistication of Norwegian ETO companies is found to be low. In detail; purchasing's position; the skills of the purchasing professionals; and the nature of purchasing's activities are all considered low utilizing this research method. Hence, we see diverging evidence within two factors of purchasing sophistication, in that the two research methods applied provided different evaluations. However, triangulation of theory, survey – and action research, establish that Norwegian ETO companies' orientation towards clerical duties is high.

As such, we argue that purchasing sophistication is reflected in the purchasing practice of ETO companies, in that the identified purchasing practice, both from theory and empirical findings, indicates that the factor of orientation on clerical duties is high. The factors of purchasing position within the company, and skills of purchasing professionals, are ambiguous.

RQ4: How can a purchasing portfolio approach be adapted to, and used by, an ETO company with similar characteristics as Fugro?

In order to answer the fourth research question, we analyzed the link between purchasing portfolio approaches and the ETO production situation. As a previously proposed purchasing portfolio approach for the ETO production situation was discarded with action research, a new purchasing portfolio approach was proposed on the background of the segmentation model developed when answering the second research question. Positioning Fugro in the developed segmentation model led us to suggest that the approach by van Weele (2010) is a suitable approach for ETO companies with the same characteristics as Fugro.

This approach was further adapted to the ETO context by limiting the strategies provided for the strategic quadrant to the supplier dominated segment, hence, proposing a defensive position when searching for new suppliers of components classified in this quadrant. This was done due to the power characteristics that are prevalent in the buyer-supplier relationships for ETO companies. Action research findings further supported this adaption, in that recommended strategies from purchasing portfolio approaches may not be feasible.

Finally, an ETO company with the same characteristics as Fugro may use the proposed purchasing portfolio approach in accordance with the provided guidelines for use. These guidelines are developed from action research, and seek to take both processual and ETO specific factors into account when operationalizing the purchasing portfolio approach. Namely, these guidelines are: (1) address each of the measures systematically; (2) it should be explicitly stated that the names of the quadrants and dimensions not are measures themselves; (3) have employees from different organizational functions participating in the process; (4) the arena and process of using a purchasing portfolio approach should stimulate discussion, formalization of practice, and codification of tacit knowledge; (5) make sure that you are talking about the same

component; and (6) time, resources and a dedicated person should be assigned to see that the implementing is successfully carried out.

How does the level of purchasing sophistication affect the use of purchasing portfolio approaches in Norwegian ETO companies?

Through answering our first research question, we developed the foundation for answering the three subsequent research questions. The second research question established the link between purchasing portfolio approaches and the purchasing sophistication, developing a segmentation model connecting purchasing sophistication characteristics to prevalent purchasing portfolio approaches. The third research question answered how purchasing sophistication is reflected in the purchasing practice of ETO companies. As such, the question provided a connection between ETO and the level of purchasing sophistication, through an assessment of the level of purchasing sophistication of such companies. Our last research question built on the aforementioned connections, when utilizing the segmentation model developed to recommend a suitable purchasing portfolio approach for ETO companies with similar characteristics as Fugro. This was based on the assessment done in answering the second research question. Through our mixed methods approach, we have been able to emphasize the benefits to be reaped by, and add guidelines for easing the implementation of, a purchasing portfolio approach. As such, we argue that through employing our refined framework, we established a connection between each main topic in the ternary relationship between purchasing portfolio approaches, purchasing sophistication and engineer-to-order. This led to a proposed purchasing portfolio approach for ETO companies with similar characteristics as Fugro. Consequently, we argue that we in a tidy and extensive manner have provided an answer to our overall problem formulation.

13 Limitations, further research and implications for the case company

In this section, we present the major limitations of our research, and suggest topics for further research in relation to these limitations. Finally, implications for important stakeholders are given.

13.1 Limitations and further research

Empirical testing

One limitation of this thesis is the lack of empirical testing of some of the concepts introduced. First, as the discussion on the adapted purchasing portfolio model (11.3.2) is of an analytic, conceptual nature, the model may not be as applicable in practice for ETO companies as proposed. Therefore, studying the use of this model in practice, together with the proposed guidelines, should be an issue in further research. A lack of empirical testing of purchasing portfolio approaches, in general (3.4.2), also favors further empirical testing such a model. We argue that action research, as conducted in this thesis, is an appropriate research method for such empirical testing, as we feel that this research method yielded information beyond what other, more passive, research methods would have done.

Further, we have argued that the concept of purchasing development models is of highly conceptual nature, and that it is not empirically tested (4.2.2). As this concept constitutes a part of the body of knowledge in purchasing literature, we argue that empirical testing is essential in determining how this concept relates to reality. We propose that thorough case studies may be an appropriate approach for investigating this concept empirically. The studies should be conducted both within different industries, like the ones van Weele (2010) place in his model (4.2.1), and within different production situations, as we have done in this thesis - in order to increase its applicability for companies in different industries and production situations.

Sources of evidence

A second limitation of this report is the use of only one case company. We argue that the case company is representative for ETO companies, but acknowledge that the external validity of only using one case company is low. By conducting multiple case studies, using a replication logic (Yin, 2009), more valid generalizations can be made, similarities and differences identified, and theories established.

Action research

The main limitation in our action research is that we preferably should have participated in a longer action research process with the problem holder. Due to time and resource constraints, we only got to the “action stage” in the action research cycle (2.3.4). As we found many interesting findings up to this stage in the cycle, we argue that further research should comprise of finishing such an action research process, to further enhance the understanding of the use of purchasing portfolio approaches in ETO companies, and how purchasing sophistication relate to these research topics. As we have given extensive descriptions of how action research was conducted in this thesis, we argue that the research design is easily replicated, and that an

external researcher as such could either re-do the research, or merely continue the research process.

Survey research

The main limitation of our survey research is related to its external validity, as we were not able to establish a sampling frame - which is a premise for using a form of probability sampling (2.4.6). However, because of our high response rate from the NCE samples (6.2.1.), which were proven not be subject for nonresponse bias (6.2.6), we argue that our survey findings is representative for the total NCE sample. From this we argue that our survey research findings may be generalized to Norwegian maritime companies organized in NCE. However, further research should be conducted in terms of establishing a sampling frame of Norwegian production companies, enabling probability sampling with a subsequent investigation of Norwegian production companies as a whole.

Establishing causalities

In our survey research, we found several significant relations between various variables tested: Purchasing-to-turnover ratio and having a sourcing strategy; having a sourcing strategy and company size; having a sourcing strategy and the purchasing portfolio analysis; having a purchasing department and company size; the use of purchasing portfolio analysis and having a purchasing department; company size and purchasing portfolio analysis (Figure 39). However, survey research cannot address causalities between these variables (2.4.5). We have throughout the analysis indicated the direction of these relationships, but acknowledge that further research should be conducted for establishing causality. To prove causalities, we propose that experiments or longitudinal studies should be conducted.

Cross-functional integration

Throughout the thesis, the concept of cross-functional integration and collaboration has been evident in various discussions. First, the use of cross-functional teams are a characteristic of a purchasing function of high development (4.2.1), and the skills to participate in such a team is an indicator of purchasing sophistication (Table 21). Second, it is identified in theory that the use of purchasing portfolio approaches may facilitate cross-functional coordination and communication (3.3.1). Third, cross-functional integration is identified as a need in ETO companies (5.3). As such, we see that all three topics in the ternary relationship (purchasing portfolio approaches, purchasing sophistication and engineer-to-order), in various degrees, address cross-functional integration. From this, we argue that further research could be done for investigating how cross-functional integration relates to these topics in practice. A plausible hypothesis is that the use of PPA may enhance cross-functional integration, which again increases purchasing sophistication. We argue that both of these implications favor the use of purchasing portfolio approaches for ETO companies. Action research, case studies, experiments and longitudinal studies may be interesting research methods to utilize in such an investigation.

Appropriateness of purchasing portfolio approaches

The extent to which it is equally desirable for all companies in all industries to adapt a purchasing portfolio approach, should also be a topic for further research. Pagell et al. (2010) highlighted the importance of this topic, in discovering that several market leading companies

performed well despite that they neither used a purchasing portfolio approach nor alternative purchasing tools. Thus, it should be important to prove the value of incorporating purchasing tools, before committing resources in an attempt to improve such tools.

The need for purchasing sophistication

In theory, it is assumed that all companies are better off with a highly sophisticated purchasing function. This is reflected in both in purchasing development models - e.g. van Weele (2010), and the discussion of purchasing sophistication - e.g. Schiele (2007). However, Dubois and Wynstra (2005) argue that a purchasing function could do a good job in terms of performance, even though it does not operate at the highest possible level of sophistication. They point out that in specific cases, like in small firms, this may be the case; the higher skills and concomitant high salaries, together with expensive supporting technologies that may come with higher levels of sophistication, may be a too high price to pay compared with the potential improvements (Dubois and Wynstra, 2005). We agree in this line of argument, and propose that further research should be conducted in order to investigate whether a high level of purchasing sophistication is a goal in itself for all companies. While being outside of the scope of this master's thesis, we argue that identified literature from Stabell and Fjeldstad (1998) could be of interest in such an investigation, addressing three distinct generic value configuration models required to understand and analyze firm-level value creation. Further, we propose case studies to be a suitable research method for such an investigation. Case studies should be conducted on a variety of companies; of different size, in different industries and within different production situations.

13.2 Implications for management

This thesis has implications for two different stakeholders; the MARGIN research project and Fugro. First, our research has made a contribution to the MARGIN project, within the research area of supplier collaboration and management. First, we proposed a segmentation model that separates various purchasing portfolio approaches in terms of their purchasing sophistication. This model may be applicable for both Fugro and the other MARGIN collaborators, in finding a suitable purchasing portfolio approach, given a company's purchasing sophistication. Second, we have proposed a purchasing tool applicable for ETO companies having much of the same characteristics as Fugro – which can be utilized in the MARGIN project. We argue that this tool may facilitate cross-functional integration, codification of tacit knowledge, formalization of strategies and communication. Further, the use of such a purchasing tool will provide a differentiated sourcing strategy, and we argue that the use of such a tool may contribute to enhancing the strategic recognition of purchasing and enable pro-active sourcing. A purchasing portfolio model may also enhance the understanding of the complex sourcing context prevalent for ETO companies.

The model recommended for Fugro, and other ETO companies with similar characteristics, is the purchasing portfolio approach by van Weele (2010) with minor adaptations (11.3.2). The following guidelines are proposed for use of such a model:

- ✓ Address each of the measures systematically
- ✓ It should be explicitly stated that the names of the quadrants and dimensions not are measures themselves
- ✓ Have employees from different organizational functions participating in the process
- ✓ The arena and process of using a PPA should stimulate discussion, formalization of practice, and codification of tacit knowledge
- ✓ Make sure that you are talking about the same component
- ✓ Time, resources and a dedicated person should be assigned to implementing

For Fugro, we further argue that this thesis contributes to managers in terms of a thorough mapping of the company's purchasing practice, where we argue that several findings should have implications. Through employing a purchasing portfolio approach, Fugro will gain differentiated sourcing strategies, which may enable a more pro-active and conscious sourcing practice. Further, we argue that the company is better served with an increased degree of cross-functional coordination and communication when sourcing, and propose the use of a purchasing portfolio approach to facilitate this. We further argue that a purchasing portfolio approach may help Fugro in codifying tacit knowledge and in formalizing sourcing practice. We argue that these implications also will be applicable for other ETO companies with similar characteristics as Fugro.

Finally, we argue that our research has proven that the use of a purchasing portfolio approach may enhance the skills of purchasers, and that the usage of sourcing strategies leads to a higher level of purchasing sophistication. We argue that an increased sophistication will contribute to the strategic recognition of purchasing and potential economic benefits.

14 References

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Appendices

In this part we provide relevant appendices to this master's thesis. This is done partly to ensure the quality of this research and partly as means for the reader's convenience by providing summarization of findings. The appendices included in this part are:

- A.1: Recapitulating the specialization project methodology
 - A.2: Action research protocol
 - A.3: Questionnaire
 - A.4: Approval from NSD
 - A.5: Action research observations
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A.1 Recapitulating the specialization project methodology

As the findings in the specialization project (1.1.6) constitute a point of departure for this master's thesis, we feel it necessary to provide an overview of how we executed the research leading to our conclusions. This is done to ensure *reliability*, i.e., if a later investigator conducts the same research, he or she should arrive at the same conclusions (Yin, 2009). We first present systematic combining, which is the research approach that we utilized. This is followed by a brief description of our research process, illustrated with the systematic combining framework.

Research methodology in the specialization project

To answer the research questions in the specialization project, two literature reviews and a single case study of Fugro were conducted, utilizing the systematic combining approach by Dubois and Gadde (2002). According to Dubois and Gadde (2002), case study research, due to the intertwined nature of the activities in the research process, is non-linear. For this reason, the authors claim that a standardized conceptualization of case study research, as a number of planned subsequent stages, defeats its own end. Dubois and Gadde (2002) argue that, instead, by constantly changing between different research activities and combining these activities with empirical and theoretical studies, the researcher will have a more comprehensive understanding of the studied phenomenon. In systematic combining one continuously moves between an empirical and theoretical dimension, enabling the theoretical framework, empirical fieldwork and case analysis to evolve simultaneously and continuously (Dubois and Gadde, 2002). The main components of systematic combining are illustrated in Figure 54, and are further elaborated below.

Dubois and Gadde (2002) separate between two activities which are embedded in the systematic combining process, namely *matching* and *direction and redirection*. The first activity relates to matching theory and reality. This may, for example, be the change to another theoretical framework than initially chosen, in order to better understand the empirical data that the researcher has collected. The second activity, direction and redirection, is important to enable matching; data collection is directed in line with the researcher's theoretical framework towards a narrow set of data, and Dubois and Gadde (2002) emphasize that it is important to complement this process with activities intended to discover aspects of the research that is unknown to the researcher. By making new discoveries and adding to the dimensions of the research problem, the study is redirected and a new view on the researched phenomenon is developed (Dubois and Gadde, 2002).

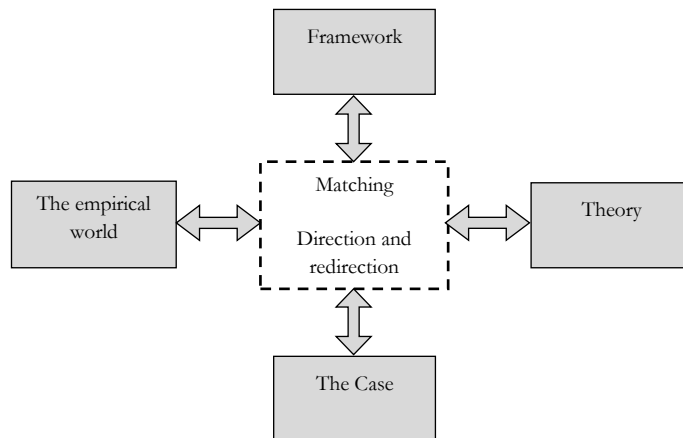


Figure 54: Main components of systematic combining (adapted from Dubois and Gadde, 2002)

According to Dubois and Gadde (2002), studies concerning the *empirical world* are often inherently difficult to limit, as no clear boundaries exist. A researcher may make new discoveries by expanding the boundaries and considering new activities or resources. However, Dubois and Gadde (2002) argue that it is vital for the researcher to set the right borders and direction for his study in order to answer his problem. As such, they propose an analytical *framework* that is both tight and allowed to evolve. Further, Dubois and Gadde (2002) explain that *the case*, as it evolves during a study, can be regarded as both a tool and a product. The first relates to the fact that empirical data can form a platform for discussion, whereas the latter relates to the finalized study, where selection and data collection has lead the researcher in some direction based on the patterns that have emerged.

During the study, a need for *theory* emerges. Dubois and Gadde (2002) claim that a researcher should not, nor has he the ability to, review all the relevant theoretical background prior to the research. Some background is necessary to analyze the studied phenomena from a theoretical framework; however, one must not be constrained by previously developed theory (Dubois and Gadde, 2002). As the authors put it, "...the 'need' for theory is created in the process" (p.559).

Research process throughout the specialization project

The specialization project began with a meeting with SINTEF, where the authors were given an introduction to MARGIN, the companies participating in the project and the companies' most pressing challenges. As such, we got an understanding of *the case*. With our initial understanding of the case, and our theoretical background, we were able to break the case down in more specific sub-cases, from which we could choose. We then chose a sub-case and a case company (Fugro). By doing this, we initiated a *matching* activity, as we wanted to utilize Fugro to determine the characteristics of an ETO company. In order to get an initial understanding of ETO companies, and to develop a *framework*, we conducted a literature review on ETO companies and their unique characteristics.

In line with the theoretical framework we developed, we continued to collect relevant data from a company visit. As such, we improved our understanding of reality (*the empirical world*). This led to a *redirection* in the study, to combine ETO characteristics with purchasing portfolio approaches. In this way the researched phenomenon was developed and the research problem finalized. We then continued to *match* this new reality by conducting an additional literature review on purchasing portfolio approaches, leading to a new theoretical framework. We then conducted an interview with Fugro, which provided empirical data necessary to answer our research questions. As such, the case became a *product* in terms of a finalized study. Figure 55 below depicts the research process throughout our specialization project.

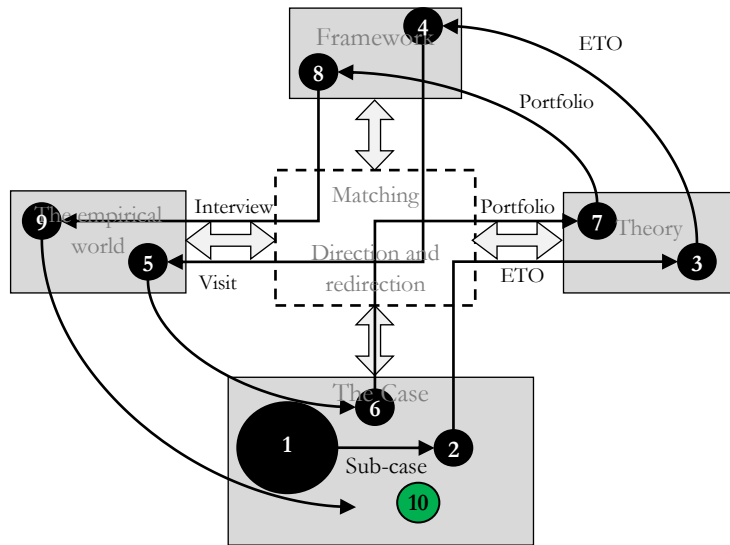


Figure 55: The research process throughout our specialization project

A.2 Action research protocol

We here present the action research protocol used when preparing and conducting the action research. The text is in Norwegian, as the action research was conducted in Norwegian. Further, it is written in an informal form as parts of it are meant to be presented orally.

Introduksjon/ved Fredrik

Presentasjon av oss selv og prosjektet

- Hei. Vi er tre studenter ved Industriell økonomi og teknologiledelse ved NTNU. Vi skriver prosjekt- og masteroppgave for MARGIN-prosjektet, som dere er deltakere i. Vårt fokus ligger oppstrøms i verdikjeden, og vi ser spesifikt på bruk av «sourcing strategier»; mer spesifikt på bruk av porteføljemodeller for innkjøp til dannelse av slike strategier. Vi har lest og skrevet mye om porteføljemodeller, og har et teoretisk perspektiv – vi føler nå at det er på tide å prøve dette ut i praksis. Vi håper også at dere kan lære noe av dette - det er en del av poenget

Forespørsel om diktafon

- For å sikre riktig gjengivelse av samtalen
- Intervjuet vil i etterkant transkriberes på bakgrunn av notater tatt av Børge, samt diktafon. Opptaket vil slettes rett etter vi har tatt en lokal kopi, for å hindre at uvedkommende får tilgang til det.

Introduksjon av de som er til stede

- Hvorfor akkurat de
- Vi ønsker også å prøve å ett kryssfunksjonelt samarbeid for å få flere vinklinger på problemstillingene vi ser på

Hva vi skal gjøre

- Vi skal i dag prøve bruken av porteføljetilnærminger for innkjøp. Det innebærer at man analyserer sine innkjøp og deretter plasserer disse i ulike kategorier, basert på forskjellige faktorer (og dimensjoner). Avhengig av plasseringen av produktet, vil man få anbefalinger om en egnet strategi for hvordan håndtere disse transaksjonene.
- Vi skal prøve å bruke et par forskjellige modeller for å belyse ulike aspekter ved en komponent man kjøper inn.
- Vi kommer til å introdusere modellen først, før vi ønsker at dere skal plassere et utvalg produkter (komponenter) som dere kjøper inn til bedriften.
- Så ser vi om det lar seg gjøre, eller om det ikke passer. Kanskje modellene klarer å belyse elementer ved innkjøp man ikke har tenkt på? Kanskje prosessen viser svakheter med modellene?
- Vår hypotese er at modellene er teoretiske å bruke. Vi er uansett fornøyd med alle utfall – alt er resultater. Vi håper også at disse modellene kan hjelpe dere med å belyse aspekter ved dagens innkjøpssituasjon som man ikke har tenkt på.

Vår rolle

- Vår rolle vil være å introdusere modellene som skal prøve å belyse ulike elementer ved innkjøpssituasjonen. Vi skal prøve å «dra dere gjennom» et utvalg modeller og styre diskusjonen rundt bruken, men det er dere som står for «arbeidet»/diskusjonen.
- En av oss vil også transkribere og observerer det vi gjør Dette vil bli behandlet konfidensielt.

Deres rolle

- Som eksperter på ulike områder i driften håper vi at dere kan være med på å belyse ulike aspekter ved en komponent/produkt.
- Vi håper at dere bidrar med deres syn på komponenter, produkter, leverandører og innkjøpssituasjonen generelt.
- Vi ønsker at dere tenker og diskuterer høyt

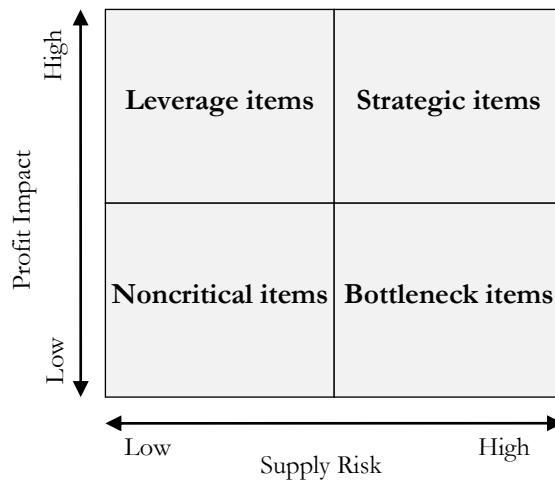
Spørsmål?

Praktiske hensyn

- Figurer vil bli vist i en power point-presentasjon
- Plassering av komponenter vil skje på ark med Post-it eller ved å tegne inn på ark.
- Samme fremgang vil bli brukt for begge workshop'ene. Designet av disse er altså likt, men vi regner med at prosessen vil gå ulike veier.
- Hver workshop varer cirka 2 timer med innlagt pause

Test av Kraljic-matrisen/ved Mads

Vi starter med å prøve den porteføljetilnærmingen som er mest brukt i dag: Kraljic-matrisen. Grunntanken her er at innkjøpsstrategi er spesifikk for hver enkel bedrift, og ved å vurdere den *strategiske viktigheten av innkjøpet* (i form av «value added», påvirkning på profitt med mer) og *kompleksiteten til innkjøpsmarkedet* (leverandørmangel, teknologiutvikling, med mer), så kan man bestemme den nødvendige innkjøpstilnærmingen. Vi bruker her en modifisert utgave av den originale porteføljetilnærmingen fra 1983. Denne tilnærmingen består av å bruke en enkelt porteføljemodell til å gi anbefalinger for hvordan håndtere ulike innkjøp. Ved å analysere hvert kjøpte produkt etter kriteriene *profit impact* and *supply risk*, kan man plassere produktet i en av fire forskjellige kategorier (vist i figuren). *Figuren vises ppt-presentasjon.*



Profit impact og supply risk er definert i form av følgende faktorer (*figuren vises ppt-presentasjon*):

Profit impact	Supply risk
Prosentandel av total kostnad (Stor andel – stor profit impact)	Antall leverandører (Få leverandører – høy risiko)
Innkjøpsvolum av produktet (Høyt volum – stor profit impact)	Leverandørens tilgjengelighet (Lite tilgjengelig – høy risiko)
Påvirkning på produktkvalitet (Stor påvirkning – stor profit impact)	Muligheter for substitusjon (Mange muligheter – lav risiko)
Påvirkning på forretningsvekst (Stor påvirkning – stor profit impact)	Risiko forbundet med å holde lager av produktet
	Grad av konkurransemessig etterspørsel (Stor konkurranse – lav risiko)
	Lage-eller-kjøpe muligheter (Om slike muligheter er lett tilgjengelig – lav risiko)

- Som et eksempel kan vi anta at innkjøp av pinner er forbundet med lav profit impact og lav supply risk, og havner i kategorien kalt non-critical. Avhengig av kategorien hvor produktet har blitt klassifisert, vil en generisk strategi bli anbefalt for hvordan tilnærme seg leverandøren. De ulike kategoriene med tilhørende strategi er gitt i tabellen under.

Kategori	Strategi
Non-critical products <i>Effektiv prosessering</i>	Ikke-kritiske produkter har en lav verdi og bedriften ønsker derfor å redusere transaksjonskostnaden til det absolutte minimum for disse produktene. Strategiene for denne kategorien sikter derfor mot å redusere transaksjonskostnader gjennom effektiv prosessering, produkt standardisering, ordrevolum og lageroptimering. E-procurement har for eksempel blitt brukt mye her i nyere tid.
Leverage products <i>Utnyttelse av innkjøpsmakt</i>	For «leverage-produkter» har bedriften muligheten til å utnytte en lav «supply risk» og bruke innkjøpsmakten, gitt ved å konsolidere innkjøpet. Strategier for denne kategorien involverer anbud, målprising, bruk av flere leverandører og utbytting av produkter, med den hensikt å oppnå en best mulig avtale. Leverandøravtalene skal også helst være kortsiktige.
Bottleneck products <i>Volum sikring, søk etter alternativer</i>	Flaskehalsprodukter representerer produkter som er viktig for leveransen av sluttproduktet, men er av lav verdi. Vanlige elementer i strategier innenfor denne kategorien er volumsikring, leverandørkontroll og sikkerhetslager, og backup-planer.
Strategic products <i>Partnerskap med leverandør</i>	For strategiske produkter er det fordelaktig å danne et partnerskapsforhold med leverandøren for å redusere risiko gjennom felles tillit og forpliktelser. Et nært og langsiktig samarbeid med leverandøren vil lede til forbedringer i produkt design og utvikling, kvalitet, ledetid og kostnadsreduksjon.

Vi ønsker at dere skal prøve å plassere produkter som dere kjøper inn. Bruk konsensusmetoden.

Plassering av komponenter

Vi ønsker at dere plasserer følgende komponenter:

- Fortøyning
- Treghetssensor
- Skall
- Datalogger
- Batteripakke

Evaluering for hver kategori

- Hva er dagens praksis for denne type produkt?
- Hvorfor er dagens praksis slik?
- Hvorfor et produkt er plassert i den spesifikke kvadranten?
- Er posisjonen i henhold til forventningene?
- Hva er tolkningen av resultatene?

Presenterer deretter hvilken generell strategi som gjelder for denne kategorien av produkter

Diskusjon

- Sammenlikne med dagens praksis.
- Hva er hovedforskjellene mellom anbefalt og implementert praksis?
- Er anbefalt praksis realistisk? Hvorfor, hvorfor ikke?

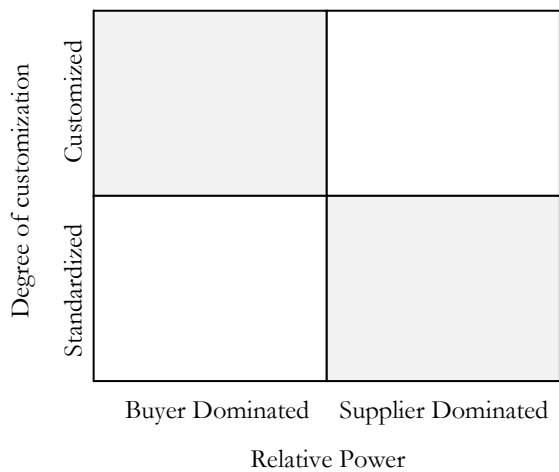
- Hva kunne ha blitt gjort annerledes?
- Aktuelt å ta i bruk? Hvorfor, hvorfor ikke?

Evaluering av hele modellen

- Synes dere modellen har noen verdi? Hvorfor, hvorfor ikke?
- Aktuelt å ta i bruk? Hvorfor, hvorfor ikke?
- Hva kan vi gjøre annerledes?

Test av egenutviklet modell/ved Fredrik

- Vi skal nå prøve en modell som tar høyde for noen andre faktorer; henholdsvis maktforhold og grad av tilpasning på komponent Den ser slik ut. *Figuren vises ppt-presentasjon.*



- Med “degree of customization” mener vi hvor tilpasset en komponent er til dere. Hvis den er veldig tilpasset er saken en annen enn om den ikke er tilpasset (standardisert). Spørsmål rundt ledetid kommer inn i bildet- tilpassede produkter er ikke på lager og vil potensielt ta lang tid å få tilgang til. Standardkomponenter kan derimot holdes på lager.
- Et spørsmål om prioritet kommer også inn i bildet. Er dere en prioritert kunde med et godt forhold til leverandøren, vil komponenten kanskje kunne leveres tidligere enn hvis dere er en mindre viktig kunde. Dette gjenspeiles også noe i «relative power» - hvordan maktforholdet mellom dere og leverandøren til komponenten er. Hvis man er en «ubetydelig kunde» er det vanskelig å bli prioritert og man kan ikke legge press på leverandøren hva angår forhandlinger, tilpasninger med mer. Er man derimot en større kunde med makt i forholdet, kan man forhåpentlig presse pris, tilpasse komponenter etter ønske med mer. Til sammen sier dette noe om «feasibility» for strategier også – er det mulig å inngå langsiktige samarbeid med alle leverandører?

Eksempel:

- Hvis dere er en svært liten kunde til en veldig stor leverandør: «Supplier dominated»
- Hvis dere må ha en skreddersydd komponent: «Customized»

Plassering av komponenter

Vi ønsker at dere plasserer følgende komponenter:

- Fortøyning
- Treghetssensor
- Skall
- Datalogger
- Batteripakke

Evaluering for hver kategori

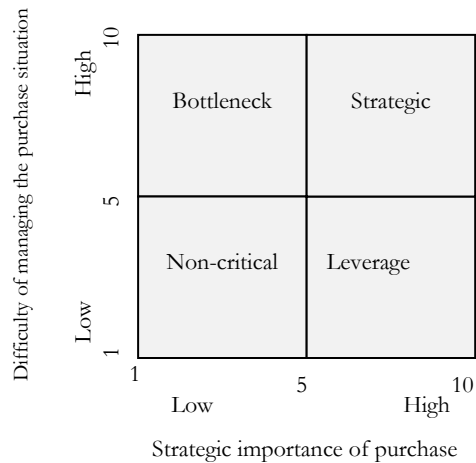
- Hvorfor et produkt er plassert i den spesifikke kvadranten?
- Er posisjoneringen i henhold til forventningene?
- Hva er tolkningen av resultatene?

Diskusjon

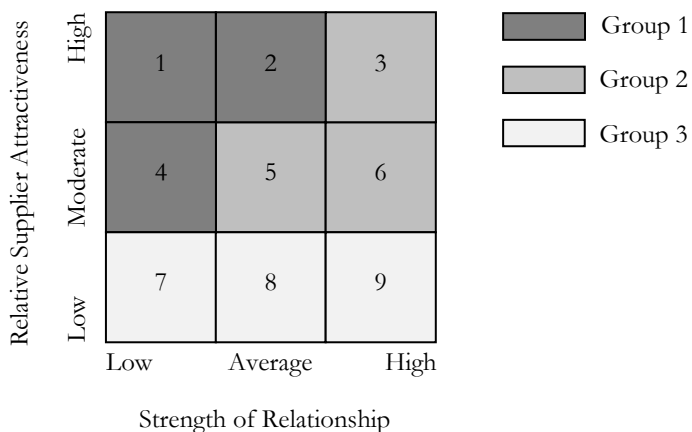
- Ga denne vinklingen mer verdi? Hvorfor, hvorfor ikke?
- Var denne lettere å forstå enn den forrige modellen? Hvorfor, hvorfor ikke?
- Kunne vi ha brukt de to sammen?
- Har dere tatt høyde for noen av disse aspektene i dagens tilnærming? Hvis ja, på hvilken måte? Hvis nei, hvorfor ikke?

Test av tilnærming av Olsen og Ellram/ved Mads

- Den siste tilnærmingen vi skal se på er mer omfattende og bruker flere porteføljemodeller.
- Olsen and Ellram laget i 1997 en porteføljetilnærming for å håndtere en bedrifts ulike bedriftsrelasjoner. Denne modellen består av tre steg.
- *Første steg* innebærer en analyse av innkjøpene til bedriften, i den hensikt å finne det ideelle forholdet mot viktige leverandører. Hvert innkjøp blir analysert i henhold til *dens strategiske viktighet* (interne faktorer) og *vanskeligheten av å håndtere innkjøps situasjonen* (eksterne faktorer). Hver av faktorene må så vektas, og en samlet poengsum vil hjelpe å plassere innkjøpet i modellen under. *Figuren vises i ppt-presentasjonen.*



- Olsen og Ellram gir følgende anbefalinger for hvordan forholdet skal håndteres, gitt plasseringen i matrisen.
- *Bottleneck*: Bedriften bør prøve å standardisere transaksjonen og kanskje søke etter substitutter
- *Strategic*: Bedriften bør etablere et nært forhold til leverandøren, og inkludere leverandøren tidlig i produkt/tjenesteutvikling. Leverandøren bør ansees som en «forlengelse» av bedriften.
- *Non-critical*: Hovedfokus er på å redusere administrative kostnader
- *Leverage*: Essensielt å oppnå en lav total kostnad. Det er også viktig å bygge gjensidig respekt, og legge til rette for fremtidig samarbeid.
- *Andre steg* har som formål å vurdere det nåværende leverandørforholdet og ta i bruk en ny porteføljemodell. I dette steget så skal leverandørforholdet vurderes og kategoriseres etter *relativ leverandørattraktivitet* og *styrken på forholdet mellom kjøper og leverandør*. Følgende tabeller lister opp faktorer som hjelper med å vurdere et forhold langs de to dimensjonene. Igjen vektet faktorene og plasseres i en ny porteføljemodell. *Figuren vises i ppt-presentasjonen.*



- I *tredje steg* analyseres resultatene fra de to foregående stegene, i den hensikt å lage handlingsplaner. Fra modellen over ser vi at de ulike cellene i porteføljemodellen tilhører distinkte grupper. Basert på hvilken gruppe det enkelte nåværende leverandørforholdet befinner seg i (porteføljemodellen over) blir bedriften anbefalt en strategi for forholdet, avhengig av kategoriseringen av det relaterte innkjøpet i porteføljemodellen fra steg 1. En beskrivelse av de ulike strategiene foreslått for de ulike gruppene er gitt i tabellen under. Tabellen vises i ppt-presentasjonen.

Group 1 (Ønskelig for selskapet på grunn av deres store attraktivitet)	Strategic	Igangsette handlinger for å styrke forholdet, og holde leverandøren lojal. Dette kan gjøres ved å stryke kommunikasjonen, gi leverandøren økt volum, eller involvere leverandøren i produktutvikling. En slik strategi er ofte svært ressursintensiv og tidkrevende, da det tar tid å skape bånd mellom bedrifter.
	Bottleneck	
	Leverage	
	Non-critical	Bedriften bør begrense bruk av ressurser i sitt mål om å styrke forholdet, eksempelvis gjennom å øke volumet til leverandøren.
Group 2 (En generell strategi er å re-allokere en bedrifts ressurser i et forsøk på å opprettholde et sterkt forhold. Det er kanskje også en mulighet for å redusere ressursforbruket gjennom å håndtere forholdet mer effektivt)	Strategic	Anstrengelser bør iverksettes for å øke leverandørens attraktivitet gjennom å redusere ressursene brukt på å styre relasjonen, selv om dette går på bekostning av styrken av forholdet (avkastningen av et sterkt forhold er i denne situasjonen lav).
	Bottleneck	
	Leverage	
	Non-critical	Bedriften må sikre leveranser i deres handlingsplaner, og ellers se etter substitutter. Motivasjonen for å bevare en leverandør øker med styrken på forholdet, da det er mer effektivt å bruke ressurser på å utvikle forholdet, fremfor å danne et nytt.
Group 3 (En generell strategi er å endre leverandør, hvis ikke den har en viktig innvirkning på selskapets nettverksposisjon. Et annet mål er å redusere ressursforbruket på forholdene i denne gruppen eller outsource innkjøpet)	Strategic	Bedriften må sikre leveranser i deres handlingsplaner, og ellers se etter substitutter. Motivasjonen for å bevare en leverandør øker med styrken på forholdet, da det er mer effektivt å bruke ressurser på å utvikle forholdet, fremfor å danne et nytt.
	Bottleneck	
	Leverage	
	Non-critical	

- Handlingsplanene som utvikles for gruppe 3 har ofte et kortsiktig fokus, i motsetning til den første gruppen. Dermed kan handlingsplanene for gruppe 3 hjelpe med å frigi,

eller tilegne seg, ressurser som kan nyttes i handlingsplanene for to andre gruppene. For hver gruppe er det viktig å håndtere en eventuell feiltilpasning mellom ressursforbruk og den relative styrken og attraktiviteten til forholdet.

- Da bedriften vil komme til å utlede flere handlingsplaner, med ulike mål og krav til ressurser, bør bedriften velge en balansert portefølje av handlingsplaner fra de ulike gruppene.

Plassering av komponenter

Vi ønsker at dere plasserer følgende komponenter:

- Fortøyning
- Treghetssensor
- Skall
- Batteripakke
- Batteripakke

Evaluering for hver kategori

- Hvorfor et produkt er plassert i de spesifikke kvadrantene?
- Er posisjoneringen i henhold til forventningene?
- Hva er tolkningen av resultatene?

Diskusjon

- Ga denne vinklingen mer verdi? Hvorfor, hvorfor ikke?
- Var denne lettere å forstå enn de forrige modellene? Hvorfor, hvorfor ikke?
- Kunne vi ha brukt de sammen?
- Har dere tatt høyde for noen av disse aspektene i dagens tilnærming? Hvis ja, på hvilken måte? Hvis nei, hvorfor ikke?

Evaluering

- Hvordan var denne modellen å bruke?
- Hva var vanskelig med den? Hvorfor?
- Belyste den aspekter som de andre ikke gjorde? Hvis ja, hvorfor?
- Ble denne for teoretisk? På hvilken måte?

Avslutning og total evaluering/ved Mads og Fredrik

Generelt

- Hvordan synes dere workshop'en var?
- Nyttig, eller ga dette lite verdi? Hvorfor?

Modellene

- Hvilken modell var enklest å bruke? Hvorfor?
- Synes dere at dere fikk noe ut av de ulike vinklingene på komponentene og leverandører? Hvorfor, hvorfor ikke?

-
- Hva var vanskeligst med bruk av modellene? Hvorfor?
 - Ble dette for teoretisk? På hvilken måte? Vanskelig å forholde seg til begrep? Ikke virkelighetsnært i det hele tatt?
 - Hva var det mest verdi i? Prosessen eller resultatet? Hvorfor?
 - Synes dere det er hensiktsmessig å samarbeide på tvers? Hvorfor, hvorfor ikke?
 - Hva lærte de ulike avdelingene?

Se på forskjeller mellom dagens praksis og foreslått

- Hvis vi ser på de tilnærmingene dere har til leverandører i dag kontra de som ble foreslått her i dag – hva virker mest hensiktsmessig? Hvorfor?
- Er foreslåtte strategier realistiske? Hvorfor, hvorfor ikke?

Eventuelt fra oss eller fra Fugro

Takke for tiden og samarbeidet

A.3 Questionnaire

This appendix contains the questionnaire that was distributed to the sample. First the introduction will be presented, which was the first page of the questionnaire and the first thing the respondents encountered. Each question will then be presented in a chronological order. For each question a description is provided, stating what type of question it is and which type of variable it creates. The appendix ends with presenting a flowchart, showing how respondents were directed past irrelevant questions.

Introduction – Page 1

When making this introduction a number of concerns were important to attend to. First and foremost, we needed to ensure that we followed the guidelines provided by our faculty and NSD (the Data Protection Official for Research). These guidelines stipulated that the information given to the respondents should at least contain the following:

- A short explanation of the purpose behind the research project and how the data obtained from the questionnaire is to be used.
- A paragraph concerning research and personal security. Here it would be beneficial to include a statement of how the data is going to be anonymized when the collection of data is completed. Another important point to make is that since there is a possibility to track a respondent based on his IP-address, is it only in exceptional cases one can write that the respondents will be anonymous. One should rather state that the information will be handled confidential.
- Often it is useful to provide contact information in the introduction, so the respondents know who to address if they have any questions.
- Who is responsible for the questionnaire. For students, their supervisor's name and title must be included.

In addition, as we wanted to achieve the best possible response rate from our sample, we wanted to provide a good covering letter (2.3.4). Thus, when forming this introduction it was also important to follow the guidelines provided by Bryman and Bell (2007) for topics to include in an introductory statement. These guidelines are provided in the following list:

- Clearly state the identity of the person who is contacting the respondent.
- State the auspices under which the research is being conducted (e.g. university)
- If a student is doing research for a thesis – make this clear.
- Specify what the research is about and why it is important, in addition to what kind of information to be collected by the questionnaire
- Indicate why the respondent has been selected.
- Provide reassurance about the confidentiality of any information provided.
- Clearly state that it is voluntary to participate in the study.
- Explicitly explain to the respondent that he or she will not be identified or be identifiable in any way, when the results are presented.
- Provide the respondent with the opportunity to ask any questions – provide contact information of the one responsible of the questionnaire.

Together, these considerations guided our development of the introductory statement, depicted below:

Side 1 av 12

Introduksjon

Innkjøp er et fagområde som i nyere tid har fått et stadig økende fokus, og som i fremtiden vil bli en avgjørende konkurranseparameter for flere og flere selskaper. Denne spørreundersøkelsen har som formål å kartlegge innkjøpspraksis i norske bedrifter, samt viktigheten av innkjøp i bedriftene. Resultatene fra denne undersøkelsen vil bli brukt i en **masteroppgave (diplomoppgave)** innen strategisk innkjøps- og forsyningsledelse ved Norges teknisk-naturvitenskapelige universitet (NTNU).

Spørreundersøkelsen tar rundt **4 minutter** å gjennomføre (i alt **maksimalt 15 korte spørsmål**).

Informasjonen som blir innhentet fra spørreundersøkelsen vil bli behandlet **konfidensielt**, og resultatene vil bli presentert på en slik måte at ingen enkeltperson eller individuell bedrift vil bli gjenkjent. Vi vil kun spørre om navnet på deres bedrift, i den hensikt å unngå redundans i besvarelsene. Denne informasjonen, sammen med all annen innhentet data, vil bli anonymisert etter at spørreundersøkelsen er avsluttet, ikke senere enn 30.06.2012.

Som takk for hjelpen ønsker vi å gi noe tilbake til våre respondenter. Vi vil derfor i etterkant av undersøkelsen sammenfatte et notat med de viktigste funnene, som vil bli gjort tilgjengelig for de som har svart. *Dette er en unik mulighet for din bedrift til å sammenlikne egen innkjøpspraksis med andre bedrifter.*

På forhånd takk for at du deltar i denne undersøkelsen!

Hvis du skulle ha noen spørsmål, ta gjerne kontakt med,
Mads Holstad
e-mail: holstad@stud.ntnu.no
Tlf: 48263010

[Neste](#)

In the following sections each page in the questionnaire is presented, with the questions provided on the page as distinct subsection.

Company and respondent information – Page 2

Company name – First question

The first question was given in order for the respondent to state which company he was answering on behalf of, and was formulated as follows:

1. Bedriftens navn:

The intention for using this question was to avoid redundancy in the answering, in other words, ensuring that no company answered the questionnaire more than once.

This question is an open question; however, its generated variable was of no interest in our survey research analysis. The reason for this was that we aspired to handle the survey generated information with confidentiality, and keep the analysis on an aggregate level.

Number of employees – Second question

The second question was constructed in order to reveal the size of the company. The size of the different intervals was decided in order to separate between SME (Small and Medium Enterprises) and larger companies. However, since there are different conventions of what defines a SME, we utilized both the Norwegian convention (Regjeringen, 2012) and the definition provided by the European Commission (*The new SME definition*). Both these definitions are provided in the table below.

Enterprise Category	Norwegian Convention	Definition by the European Commission
Medium-sized	<100 employees	<250 employees and ≤ € 50 million
Small	<20 employees	<50 employees and ≤ € 10 million
Micro	Not defined	<10 employees and ≤ € 2 million

Adjusting for both these conventions lead us to construct the following question:

2. Hvor mange ansatte er det i bedriften?

Hvis du er tilknyttet en forretningsenhet i et større konsern, inkluderer bare de ansatte i forretningsenheten.

- Mindre enn 20 ansatte
- 20 til 49 ansatte
- 50 til 99 ansatte
- 100 til 249 ansatte
- 250 til 499 ansatte
- 500 til 1000 ansatte
- Flere enn 1000 ansatte

The table below provides the more practical specifications about the question.

Practical specifications (2.question)	
Type of question	Closed
Type of variable created	Ordinal

Job title – Third question

It was important to assess to which extent the respondent possessed sufficient information about the purchasing operations within his or hers company. In order to achieve this evaluation, we asked for the job title of the respondents, as we believed this would be an important indicator.

When developing a set of different job tiles which we would expect to find, we used a wage statistics published on behalf of NIMA. From this wage statistic we found inspiration to develop the following set (depicted below) of different job titles, from which the respondents could choose.

3. Hva er din stillingstittel?

- Innkjøpsdirektør (Director Purchasing)
- Innkjøpssjef (Purchasing Manager)
- Senior Innkjøper (Senior Buyer)
- Innkjøpsassistent (Purchasing Assistant)
- Innkjøper (Purchaser)
- Innkjøpsrådgiver (Purchasing Consultant)
- Verdikjedeleder (Supply Chain Manager)
- Logistikkdirektør (Director Logistics)
- Logistikkjef (Logistics Manager)
- Produksjonssjef (Production Manager)
- Rådgiver/Konsulent (Consultant)
- Annet, vennligst spesifiser

The table below provides the more practical specifications about the question, however this question was not to be used in the analysis, only as a means for evaluating the external validity of the quantitative research.

Practical specifications (3.question)	
Type of question	Closed
Type of variable created	Nominal

Type of industry – Fourth question

As a further means for assessing the external validity of our findings, or more specific if our sample was representative of a larger population, we asked for the type of industry in which the company had his main operations. The different possibilities in which the respondent could choose amongst was deduced based on previous survey research within the field of purchasing (Quayle, 2002; Gelderman and van Weele, 2005). In addition, anticipating that some of our respondents would be associated with the energy sector or the oil and gas industry, these two options was added. The fourth question is depicted below.

4. Hvilken industri er **mest beskrivende** for selskapets operasjoner?

- Elektronikk og ingeniørvirksomhet
- Kjemikalier
- Maskin
- Trevirke, møbler eller papir
- Metallvirksomhet
- Olje og gass
- Energi
- Pakking og distribusjon
- Høyteknologi
- Finansrelatert
- Konstruksjon
- Offentlig
- Tjenestevirksomhet
- Produksjon
- Annet, vennligst spesifiser

The more practical information about the question is given in the table below. Again, this question's main purpose was to evaluate the quality if the quantitative and not to be used in the analysis.

Practical specifications (4.question)	
Type of question	Closed
Type of variable created	Nominal

Production situation – Page 3

Important to our research and the purpose of this questionnaire was the collecting of data concerning the production situation to the respondent's company. Thus our fifth question asked the respondents as to which production situation was most descriptive for his or hers company and it had the following format.

5. Hvilken produksjonssituasjon er **mest beskrivende** for deres bedrift?

Make-to-stock (MTS):

MTS: Vi produserer og ferdigstiller varer til lager, og leverer etter bestilling fra kunde.

Assemble-to-order (ATO):

ATO: Vi har komponenter og halvfabrikat på lager, men setter sluttproduktene sammen etter konkret bestilling fra kunde.

Make-to-order (MTO):

MTO: Vi kjøper inn råvarer, produserer deler og setter sammen sluttproduktet kun etter konkret bestilling fra kunde, produktdesign og engineering(ingeniørvirksomhet) er gjort i forkant.

Engineer-to-order (ETO):

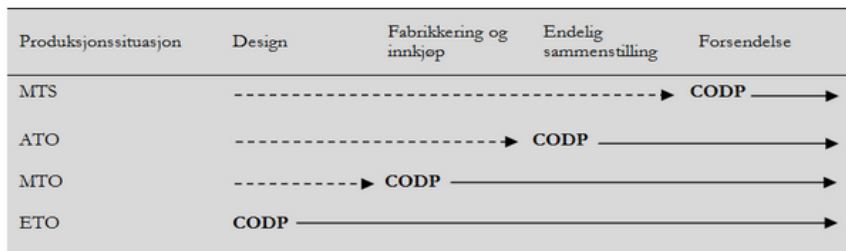
ETO: Vi produserer (nesten) unike produkter; innkjøp, produktdesign, maskinering, sammenstilling osv, gjøres hovedsakelig først etter konkret bestilling fra kunde.

Vi er ikke et produksjonsselskap

As we anticipated that not all companies in our sample knew of these different production situations, we provided a description of each possible situation in relation to each answer. In addition, we provided some further explanations, for those respondents who wanted a more elaborate definition. This additional information was as follows and was based on Olhager (2003):

Ytterligere forklaring:

Figuren under (tilpasset fra Olhager, 2003) viser de fire produksjonssituasjonene i sammenheng med kundeordrens dekoblingspunkt (CODP). Kundeordrens dekoblingspunkt er definert som det tidspunktet hvor produksjonen går fra å være prognosedrevet til å bli etterspørselsdrevet; i figuren betyr en stiplet linje prognosedrevet aktivitet, mens en heltrukket linje betyr kundeordredrevet aktivitet.



This important question's practical specifications are described in the table below.

Practical specifications (5.question)	
Type of question	Closed
Type of variable created	Nominal

Company turnover and spending – Page 4

On the fourth page the respondents were asked to state the company's annual turnover and cost of goods sold (COGS). The intention behind this question was to measure the respondents *purchase-to-turnover ratio* (COGS divided by the annual turnover), as we perceived this ratio as an important indicator of the importance of purchasing for a company (6.1.4). In addition, we wanted to evaluate this ratio's effect of other relevant variables included in the questionnaire.

Each respondent was asked to answer in amounts of 1000 NOK, and if necessary round the amount to the nearest 1000 NOK. The reason for this was that we knew that accounting figures are often given in this magnitude, thus making it easier for the respondent to provide answer.

6. Hva er din bedrifts årlige omsetning, fra siste tilgjengelige regnskapsår (1000 NOK)?*

Vennligst rund av beløpet til nærmeste tusen.

7. Hva er bedriftens totale varekostnader (cost of goods sold), fra siste tilgjengelige regnskapsår (1000 NOK)?*

Med varekostnad menes forbruk av innkjøpte handelsvarer. Dette omfatter solgte varers inntakskost og svinn (www.ssb.no). Vennligst rund av beløpet til nærmeste tusen.

In relation to the analysis, the following specifications of these two questions are of interest.

Practical specifications (questions 6 and 7)	
Type of question	Open
Type of variable created	Interval/ratio

The calculated purchasing-to-turnover ratio will inhabit the same practical specifications as mentioned in the table below.

Purchasing department – Page 5

As a means for getting an indication of the priority of purchasing within a company (6.1.1), we asked the respondents if they had their own dedicated purchasing department. Quayle (2002) employed a similar question; as such, we were able to compare our results with prior research. Hence, the respondents were asked the following question.

8. Har din bedrift en egen innkjøpsavdeling?

Ja

Nei

Annet, vennligst spesifiser

For those respondents which stated that their company had a dedicated purchasing function, an additional question revealed itself, asking how many were employed by this department. This was done in order to establish an average size of a purchasing department.

In addition, this question acted as a filter question, guiding respondents past the ninth question and directly to the tenth question if they answered "yes". A flow chart at the end of this appendix depicts the use of filter questions and redirection of respondents, dependent on how they answered. The more practical specifications about the question are provided in the table below.

Practical specifications (8.question)	
Type of question	Closed
Type of variable created	Dichotomous

Purchasing responsibility – Page 6

As previously mentioned, only those companies in which they did not have their own purchasing department, would receive this question. The intention of this question was to uncover, in the absence of a purchasing function, if the company had acknowledged the importance of purchase at least to an extent that they had a dedicated position within the firm, handling this operation.

9. Har du eller andre et ansatte dedikert ansvar for å kjøpe inn varer til bedriften?

- Ja
- Bare delvis ansvar
- Nei
- Annet, vennligst spesifiser

In a similar manner as the prior question, if the respondent said to have dedicated employees handling the purchasing operations, an additional question revealed itself, asking how many employees had such a position. Again, the average number of employees with this responsibility was of interest in relation to the research.

When analyzing the survey data, the following information about the question is important.

Practical specifications (9.question)	
Type of question	Closed
Type of variable created	Nominal

Sourcing strategy – Page 7

In order to investigate the link between using a purchasing portfolio approach and having a sourcing strategy, we asked if the respondent's company had any sourcing strategies (6.1.2). We also suspected that this variable may be related to the level of sophistication (6.1.2).

10. Har din bedrift en sourcing-strategi, eller retningslinjer ved gjennomføringen av en innkjøpsbeslutning?

Definisjon av sourcing-strategi: En sourcing-strategi beskriver hvor mange leverandører selskapet ønsker for det bestemte produktet eller produktkategorien, hvilken type forhold man skal etterstrebe og hvilken type kontrakt man vil forhandle frem (van Weele, 2010).

- Ja
- Bare for noen enkelte produkter
- Nei
- Annet, vennligst spesifiser

As we suspected there to be many different understandings of what comprises a sourcing strategy, amongst our respondents, we provided a definition given by van Weele (2010). Further, this question acted as a filter question for the two succeeding questions (a closer explanation is provided by the flowchart at the end of this appendix), and additional specifications is given in the table below.

Practical specifications (10.question)	
Type of question	Closed
Type of variable created	Dichotomous (the first two answer options were combined)

Cross functional teams – Page 8

When developing sourcing strategies for different categories of products, several authors recommend the use of cross-functional teams (e.g. Monczka et al, 2011; van Weele, 2010). As such, we wanted to investigate if the use of cross-functional teams were as prominent in practice, as one could suspect from theory.

11. Benytter dere kryssfunksjonelle team når det skal etableres en ny sourcing-strategi?

(Eksempelvis, samarbeider ansatte fra produksjon og markedsføring sammen når de former retningslinjer for selskapets innkjøp?)

- Ja
- Til en viss grad
- Nei

In addition, this question was a filter question, which guided the respondent past the next question if he or she were to answer “No” (a closer explanation is provided by the flowchart at the end of this appendix). The practical specifications of the question are provided in the table below.

Practical specifications (11.question)	
Type of question	Closed
Type of variable created	Dichotomous (the first two answer options were combined)

Departments collaborating – Page 9

When indeed the company used cross-functional teams to develop sourcing strategies it would be beneficial to know which departments that typically were represented in this team. Hence, the following question was given to the respondents.

12. Hvilke avdelinger deltar i det kryssfunksjonelle sourcing-teamet?

- Innkjøp
- Salg/markedsføring
- Produksjon
- Forskning og utvikling
- HR
- Finans og regnskap
- Vedlikehold
- Annet, vennligst spesifiser

Additional specification of the question is presented in the table below.

Practical specifications (12.question)	
Type of question	Closed
Type of variable created	Nominal

Use of purchasing portfolio analysis – Page 10

This next question was provided to us by Professor Arjan van Weele and Associate Professor Kees Gelderman, and asked the respondent how often the company employed a purchasing portfolio analysis. The question had the following form in the questionnaire.

13. Hvor ofte brukes porteføljeanalyse for innkjøp i din bedrift?

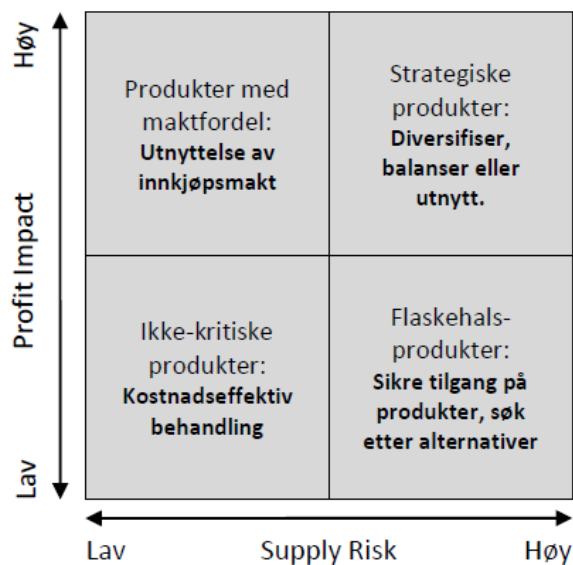
- Aldri
- Mindre enn én gang i året
- Rundt én gang i året
- Mer enn én gang i året

However, as we suspected that several of our respondents had not heard of such an analysis, a short introduction to purchasing portfolio analysis was provided together with a description of the intention behind these analyses:

Porteføljeanalyse for innkjøp

Porteføljeanalyse for innkjøp er brukt som et verktøy for å utarbeide differensierte leverandørstrategier. Figuren under (tilpasset fra Gelderman og van Weele, 2005) viser Kraljic-matrisen, som er et eksempel på et slikt verktøy. Den fundamentale idéen bak denne typen analyse, er at siden leverandører representerer forskjellige interesser for bedriften, så må det utvikles differensierte strategier mot bedriftens leverandører (van Weele, 2010).

Porteføljeanalyser for innkjøp separerer de produkter og materialer bedriften kjøper i forhold til variable (eksempelvis Profit Impact og Supply Risk) og plasserer disse i en av fire kategorier (kvadranter) i en 2 x 2 matrise. Avhengig av deres plassering i matrisen (kategori), anbefales en generisk sourcing-strategi for de forskjellige produktene og materialene.



As there exist a wide range of different types of purchasing portfolio approaches available to conduct a portfolio analysis, it was important to explicitly state that the Kraljic matrix presented as an example was one of several possible choices. Further, Gelderman and van Weele (2005) assigned each answer a score, in order to separate between purchasing portfolio users and non-users; these are given in the following table:

Answer	Score
Never	0
Less than once a year	1
About once a year	1
More than once a year	1

Consequently, despite there being four different fixed answers, in reality there were only two different categories (those answers with score 1 and those with score 0). Thus the variable created by the question was dichotomous.

Practical specifications (13.question)	
Type of question	Closed
Type of variable created	Dichotomous

Reasons for not utilizing such a model –Page 11

Pending that several of our respondents would not be accustomed with the use of a purchasing portfolio analysis, we included this fourteenth question in order to find the reason why. The different answers were deduced through a discussion with our supervisor, and by adding an “other” response category we could capture additional reasons.

14. Hvorfor bruker du ikke porteføljeanalyse for innkjøp?

- Aldri hørt om det
- Har ikke tilstrekkelig med ressurser til å utføre en slik analyse
- Ser ikke behovet
- Har prøvd, men mislyktes
- Har prøvd, men fant den ikke nyttig/nødvendig
- Bruker egen metode for å gruppere eller klassifisere produkter/tjenester som kjøpes fra eksterne leverandører
- Annet, vennligst spesifiser

The more practical specifications of the question are provided in the following table.

Practical specifications (14.question)	
Type of question	Closed
Type of variable created	Nominal

Purchasing Sophistication – Page 12

In order to measure the important concept of purchasing sophistication we adopted a multiple-indicator measure given by Associate Professor Kees Gelderman and Professor Arjan van Weele. Each indicator corresponds to a characteristic of purchasing sophistication indentified from theory (Table 21). This multiple-indicator measure was presented to the respondents, as depicted below:

15. Vennligst indiker i den grad du er enig i de følgende utsagnene *

	Svært Uenig	Uenig	Nøytral	Enig	Svært Enig
Innkjøp rapporterer direkte til toppledelsen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ledelsen synes at innkjøp bidrar betydelig til konkurranseposisjonen til bedriften.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aktivitetene til innkjøperne i din bedrift er hovedsaklig orientert mot administrative oppgaver og håndteringen av daglige problemer med leverandører (administrative oppgaver).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Våre innkjøpstrategier er hovedsaklig orientert mot samarbeid med leverandører.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Innkjøpere i vår bedrift har tilstrekkelig med ferdigheter til å arbeide i kryssfunksjonelle team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Innkjøpere i vår bedrift har tilstrekkelig med ferdigheter til å utvikle innkjøps og leverandørstrategier.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Measures to ensure the quality of this multiple indicator measure is described in our methodology chapter (2.4.2). In the table below, we provide the practical information of the variable generated from this question.

Practical specifications (15.question)	
Type of question	Closed, Likert-Scale
Type of variable created	Each indicator by itself constitutes an ordinal variable. When analyzing the sophistication of the purchasing function, the indicators are combined to create an interval/ratio variable – indicating the total purchasing sophistication score.

Completing the survey

As the respondents completed the last question (question 15) and clicked on the “finish” button, they received the following message, thanking them for providing valuable information for our research:

Fullført !

Igjen, takk for at du fullførte denne spørreundersøkelsen!

Et notat med hovedfunnene fra denne undersøkelsen vil bli gjort tilgjengelig for din bedrift så fort den er fullført.

Med vennlig hilsen

Mads Holstad, Fredrik Stokke and Børge Sjøbakk
Mastergradsstudenter
Institutt for industriell økonomi og teknologiledelse
NTNU

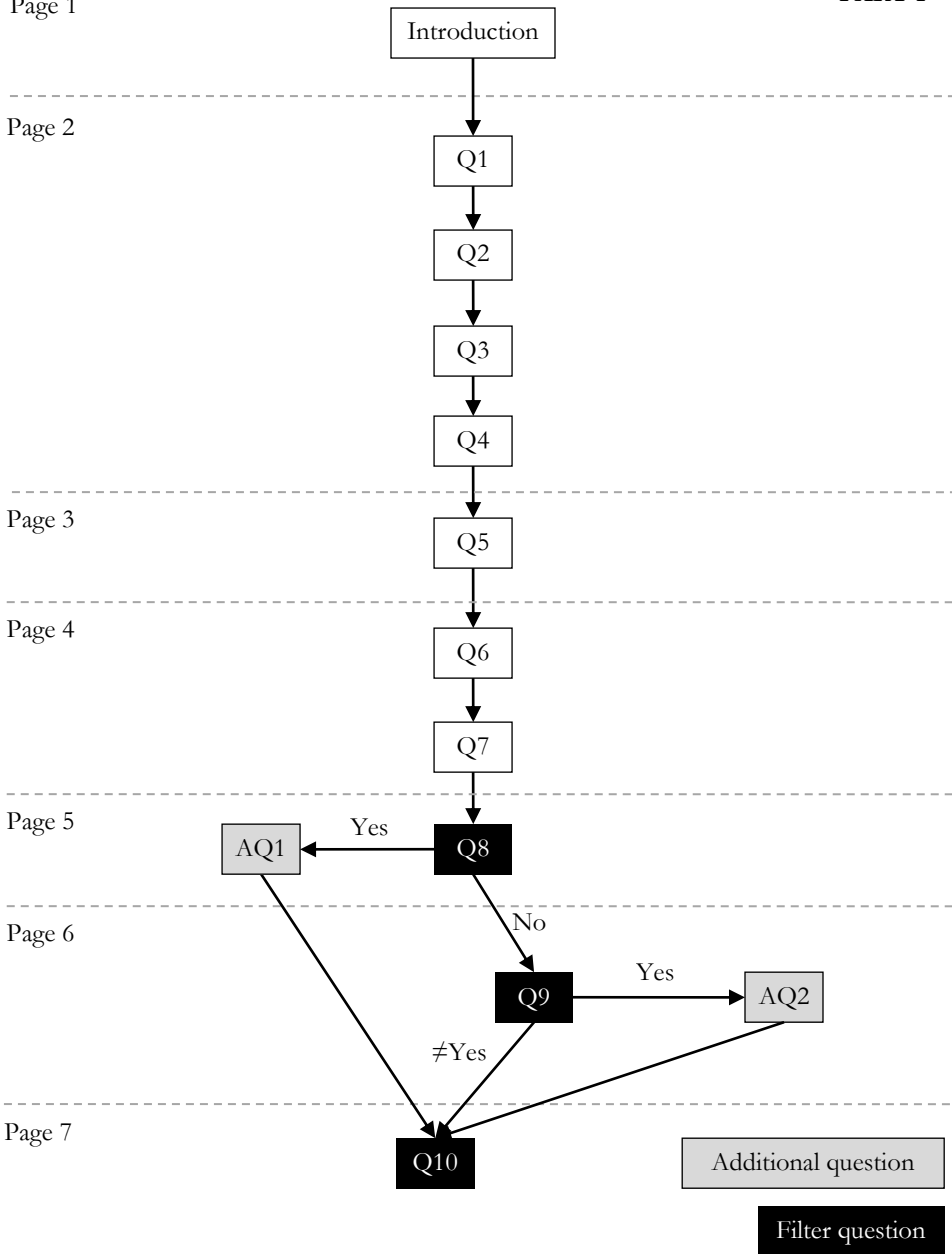
Veileder: Luitzen De Boer
Professor
Institutt for industriell økonomi og teknologiledelse
NTNU

Ha en forstøtt god dag!

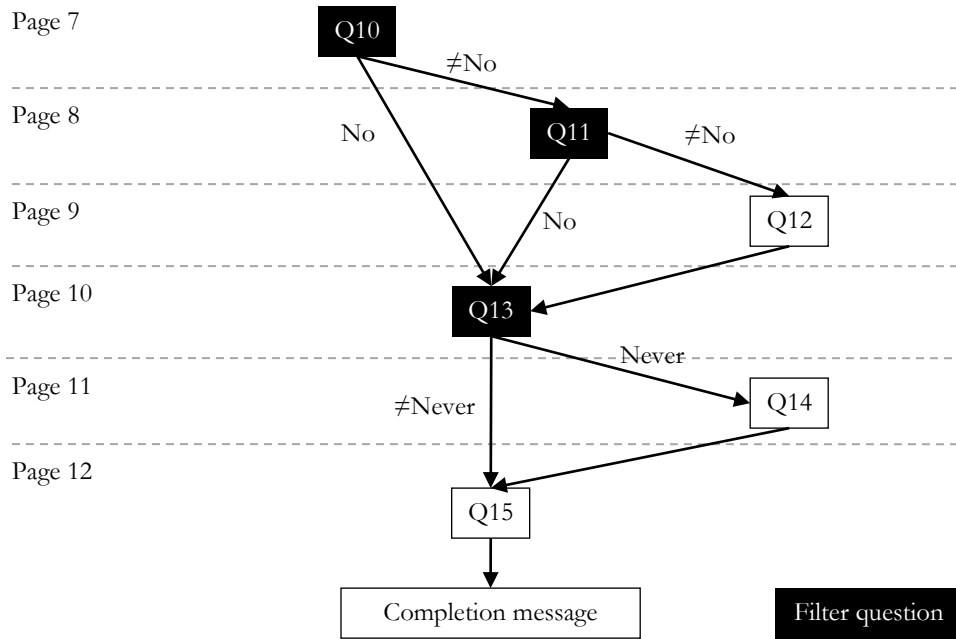
In order to shorten the introductory statement, to the bare essentials, some of the recommended information to be provided to the respondents was included in this completion message (e.g. who is responsible for the questionnaire).

Flow chart depiction of the survey

In order to show how the respondents were directed past irrelevant questions, by using filter questions, the following flow chart has been developed. The chart also shows how the different questions relate to each other, and on which pages they were presented.




PART II



A.4 Approval from NSD

Norsk samfunnsvitenskapelig datatjeneste AS
NORWEGIAN SOCIAL SCIENCE DATA SERVICES



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Fax: +47-55 58 96 50
nsd@red.uib.no
www.nsd.uib.no
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Luitzen De Boer
Institutt for industriell økonomi og teknologiledelse
NTNU
Alfred Getzvei 3
7491 TRONDHEIM

Vår dato: 22.03.2012 Vår ref:29909 / 3 / LMR Deres dato: Deres ref:

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 20.02.2012. Meldingen gjelder prosjektet:

29909	<i>Purchasing in Engineer-to-order Companies</i>
Behandlingsansvarlig	<i>NTNU, ved institusjonens øverste leder</i>
Daglig ansvarlig	<i>Luitzen De Boer</i>
Student	<i>Mads Holstad</i>

Personvernombudet har vurdert prosjektet og finner at behandlingen av personopplysninger er meldepliktig i henhold til personopplysningsloven § 31. Behandlingen tilfredsstiller kravene i personopplysningsloven.

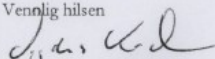
Personvernombudets vurdering forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, eventuelle kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

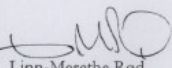
Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/forsk_stud/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, <http://www.nsd.uib.no/personvern/prosjektoversikt.jsp>.

Personvernombudet vil ved prosjektets avslutning, 30.06.2012, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen


Vigdis Namtvedt Kvalheim


Linn-Merethe Rød

Linn-Merethe Rød tlf: 55 58 89 11
Vedlegg: Prosjektvurdering
Kopi: Mads Holstad, Mellomveien 11, 7042 TRONDHEIM

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A.5 Action research observations

We here present the various observations made when conducting action research (chapter 7). The observations are classified within purchasing portfolio approach; engineer-to-order; purchasing sophistication; purchasing portfolio approach – engineer-to-order; and action research observations, respectively.

Purchasing portfolio approach observations

The following observations were made with regards to purchasing portfolio approaches.

PPA observation #	Description
1	It is not clear whether one should only evaluate the underlying measures of the model's dimension, or whether the dimension itself can be utilized as a measure.
2	Portfolio analysis participants may be passive (for whatever reason) when components that are not "their responsibility" are evaluated.
3	Users may end up discarding initial thoughts when evaluating aspects not considered previously.
4	Complex product structures make the positioning of components difficult.
5	The names of the quadrants in the model may lead to predisposition with respect to positioning, omitting the dimensions and their measures.
6	Complex product structures may make the discussion derail from the actual component in analysis.
7	Portfolio analysis participants from non-purchasing functions provide valuable information, not only in placing the sourced component, but also concerning the transaction cost of changing today's practice.
8	An initial evaluation of the dimension alone may be substantially altered as one considers its underlying measures.
9	Impact on business growth was never used to evaluate the profit impact of a product.
10	Make or buy opportunities were not evaluated without being prompted.
11	Complex product structures may cause sub-components to be forgotten in the positioning of the component, leading other sub-components to constitute the positioned component.
12	The position of complex product structures may cause sub-components to achieve a disproportionate resource allocation in relation to its actual strategic importance.

PPA observation #	Description
13	Additional measures and dimensions can make the practitioner consider more information when evaluating a sourced component.
14	Expensive products are considered more strategically important; if the relationship works and the products are inexpensive, time is not spent on changing suppliers.
15	The approach by Olsen and Ellram (1997) was preferred over the Kraljic matrix and the ETO adapted model.
16	The models were regarded as rather theoretical.
17	The approach by Olsen and Ellram (1997) was perceived as easier than the Kraljic matrix and the ETO adapted model.
18	Personnel should be dedicated to carry the responsibility of implementing the use of a purchasing portfolio approach.
19	Limited time and resources impede the implementation of a purchasing portfolio approach.
20	The implementation of a purchasing portfolio approach is a political decision, in that top management must allocate time and resources for this purpose.
21	The process was perceived more valuable than the output, the latter in terms of generic strategies.
22	Through discussion and mutual reflection, tacit knowledge may be codified, practice formalized and communication facilitated by the use of a purchasing portfolio approach.

Engineer-to-order observations

The following observations were made with regards engineer-to-order

ETO observation #	Description
1	The suppliers' work practices limit the number of available suppliers, due to their effect on the product quality.
2	Components that are made specifically to order may vary in price, and, as such, profit impact.

ETO observation #	Description
3	Some sourced components are considerably integrated in the final product; consequently, the transaction cost of changing components or suppliers may be high.
4	Co-location of functions at the same premises enables face-to-face interaction, which may compensate for the need for cross-functional integration.
5	There seems to be little appreciation for the benefits of cross-functional coordination; if employed software works as intended, this coordination would not be necessary.
6	Lack of cross-functional coordination may lead to poor performance when promises are made to customers.
7	For a small company, the facets between the different departments (such as purchasing and engineering) may be vague, and one often finds oneself working for several functions at once. As such, an employee may possess thorough knowledge of several functions.
8	Proximity, stability and good communication are preferred characteristics of supplier relationships.
9	A long-term relationship may be natural to prolong, even though the nature of the relationship changes.
10	For several of the sourced components there exists no contractual agreement with the supplier
11	The company searches for alternative suppliers, in order to establish alternatives and as a means for comparing prices.
12	A long-term relationship with a supplier may lead to the development of valuable knowledge of the supplier's operations.
13	Being a small customer may cause lower priority from the supplier (e.g., your orders may be pushed back in line due to larger orders from more important customers).
14	Long-term relationships may increase the priority from the supplier.
15	Being a small company, it is difficult to initiate close (resource intensive) relationships with large suppliers.
16	The company rarely considers changing supplier; negotiations are initiated due to major changes in the product.

ETO observation #	Description
17	Buyer power is achieved through framework agreements, bundling volumes across subsidiaries.
18	Large purchasing volumes over time increase the attention given by the supplier
19	Bargaining power is achieved by purchasing larger volumes.
20	Power is not considered ex ante; it is experienced ex post.
21	It is not necessarily best to use a smaller supplier; a bigger supplier may provide better quality products.
22	Long term relationships are difficult to terminate, as friendships evolve.

Purchasing sophistication observations

The following observations were made with regards to purchasing sophistication.

PS observation #	Description
1	Participants have predispositions regarding models proposed by academics; they do not fit their unique production situation (e.g. having low production volumes).
2	The purchasers tend to deviate when being challenged to consider practice other than what they are doing today.
3	The purchasers seem to be satisfied with the way things are, as there have not been any problems so far.

Purchasing portfolio approach and engineer-to-order observations

The following observations were made with regards to purchasing portfolio approaches and engineer-to-order

PPA and ETO observation #	Description
1	Degree of customization is hard to measure; a component may be customized in the eyes of the customer, even though subcomponents are standard products.
2	Degree of customization is hard to measure; a component may be customized in terms of being specified to the customer, and still have a standardized production process.
3	Degree of customization is hard to measure; a component may be standard in the eyes of the customer but customer specific in the eyes of the supplier.

Action research observations

The following observations were made with regards to action research.

AR observation #	Description
1	The participants of the workshops tend to hesitate, and await guidance from the researchers.
2	The participants of the workshops tend to deviate from the positioning process, and discuss other aspects than the positioning of the component.
3	The researchers have great influence on the problem holders; the problem holders tend to reply confirmatory to leading questions.
4	Experiences gained earlier in the process may be utilized with success at a later point; enhancing both the research and problem solving interest.