NTNU – Trondheim
Norwegian University of
Science and Technology

Interoperability between ERP System and Project Planning System

Thomas Gulliksen

Project Management
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Supervisor: Ole Jonny Klakegg, BAT

Norwegian University of Science and Technology
Department of Civil and Transport Engineering

FOREWORD

This report is the end result of my Master Thesis at Norwegian University of Technology (NTNU) and is the final chapter in my education – for now. The scope of the report is 30 ECTS and represents one semester of full-time studying.

There were basically two reasons that inspired me to choose this assignment. The first was that it has similarities to BIM which I have done a specialization project on earlier, which is also a topic I find fascinating. The other reason was that it was in the subsea industry which is interesting due to the technological aspect as well as the future of this industry.

I have had the privilege of working at Aker Solutions headquarters at Fornebu for this report as well as working part-time in the Planning & Scheduling sub-department. There have been busy days due to this, but working both academically and professionally together with these people has been a valuable experience. Planning Manager Sandy Spørck and Project Manager Rolf Gundersen deserve my deepest gratitude as they have provided me with valuable wisdom in matters that has been essential for this report. Also from Aker Solutions I would like to give Christopher Riffe acknowledgement for good discussions and for going beyond what was asked of him.

In addition to this I have also been very privileged to be assigned Professor Ole Jonny Klakegg from NTNU as my supervisor. He has been available for comments and feedback on my thoughts and questions in regards to the report. He has in many ways been my academic anchor and has reminded me to be an academic as much as an engineer. I would like to provide special recognition to him for his encouragement and guidance in writing this report.

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Thomas Gulliksen

ABSTRACT

SAP in an ERP system which is a digital system used in Aker Subsea to store, organize and manage information related to the company that all employees in the different functions use daily. Primavera is the time planning tool in Aker Subsea.

Today information is copied manually from SAP over to Primavera by the planners to analyze and create schedules. There exists an application that copies information between SAP and Primavera called Inspire.

Aker Subsea is interested in implementing this so that the planners will have more time to analyze and forecast potential pitfalls of the future. As the planning department in Aker Subsea has spent several years on building up their procedures, structure and manpower the time has come to implement the integration software.

As ERP systems are modular then the integration can be seen as installing a new time planning module to the ERP system and for this there is done a lot of research into.

There is a clear need for four specific things in an integration like this to be successful: “Top Management Support”, “ERP Teamwork and Composition”, “Project Management” and “Change Management Culture and Program”.

BIM is a similar system to ERP, but with different functions. Research on this can be valuable to ERP implementations. As more research is done to BIM it becomes clear that interoperability between software is needed on many levels and between several disciplines. As time and progress is registered in the ERP system it is highly relevant to have that information in the planning tool.

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CHAPTER 1

1 INTRODUCTION

1.1 BACKGROUND

SAP ERP (SAP) is a software application for ENTERPRISE RESOURCE PLANNING (ERP), a digital system used to store, organize and manage the resources, information and functions within a company. The function of SAP is to be an information hub where every department in Aker Solutions imports or exports information. PRIMAVERA P6 ENTERPRISE PROJECT PORTFOLIO MANAGEMENT (Primavera) is a software application used for planning activities, such as time and cost. Primavera is mainly used for time planning in Aker Subsea, but it has more advanced functions available as well. SAP and Primavera are two of the most used software applications for their practice in the world today, so integrating them is wanted by many. Oracle, the Primavera vendor, has already developed a middleware application for doing this integration and there are also other competitors providing similar services. The application from Oracle is called PRIMAVERA INSPIRE (Inspire) and sits in between SAP and Primavera. This is the solution Aker Subsea has decided to use for their integration project and it has been in contact with an external IT firm for technical consultancy and modification of Inspire to fit with SAP and Primavera.

The PLANNING & SCHEDULING (P&S) Sub-department in Aker Subsea provides the projects with schedules created by PROJECT PLANNER (Planner). The planners work mainly with SAP and Primavera to create and maintain the schedules. Today they export and import information from SAP to Primavera in a manual process. Due to the limiting way SAP and Primavera interacts today the focus and time of the planner is spent on creating and maintaining the schedule instead of using it.

In light of increasing control, predictability and profitability Aker Subsea initiated a restructuring of the planning department and in 2007 an integration process was explored, but it was concluded that prioritizing planning philosophy was more important. It is now time for integration as the philosophy and processes are in place and have matured. This integration is also a part of staying competitive as other competitors are working on similar integration projects.

1.2 OBJECTIVES & EXPECTATIONS

The reason for writing this report is to create an academic foundation for the integration between SAP and Primavera in Aker Subsea.

From the background that is mentioned above there are two issues that can be derived. One is the system definition governing how Inspire should be configured. The other is the issue of how the actual implementation should be executed. From these two concepts there the following questions that should be answered:

1. How should the integration be implemented successfully?
    a. How can related research benefit this integration?
    b. What are the potential pitfalls?
2. What type information is relevant to transfer?
3. What is the expected effect on the organization and the culture?

1.3 ASSUMPTIONS & LIMITATIONS

It has been assumed that the challenges with integrating SAP and Primavera is assumed to mostly relate to system design and architecture and not necessarily the technical aspect of programming and configuring the software application to do the information exchange. Therefor the level of detail in the integration does not go down to details such as which specific data-fields is transferred between SAP to Primavera.

Both SAP and Primavera are complex software applications with many functions and it was assumed that the amount of knowledge gained within the time frame of this report would be limiting. It has therefore not been a goal to make recommendations on changing how SAP and Primavera is used in detail. As an example on this; SAP has the ability to function as a planning tool, but it is more tailored to production planning than project planning. It is not examined if SAP can replace Primavera because clients often specify that Primavera should be used and it is assumed that Primavera is far superior to SAP in regards to this type of planning. In addition to this it has not been examined in detail other alternative software applications than Inspire.

Some details not directly related to the topic of the report have been simplified to make the report easier for the reader to understand. Some of the complex structure of SAP that is used by Aker Subsea has for example not been covered in detail as this would not add anything relevant to the report.

Some knowledge of BUILDING INFORMATION MODELING (BIM) and project planning is expected for understanding this report.

1.4 METHODOLOGY

A central part of problem solving is to ask questions and find answers, so often a solution consists of the answers to a group of questions. When asking these questions an important part of research is to define *how* to answer the questions. To make this an easier task it can helpful to visualize that concept with the research pyramid. (Jonker & Pennink, 2010).

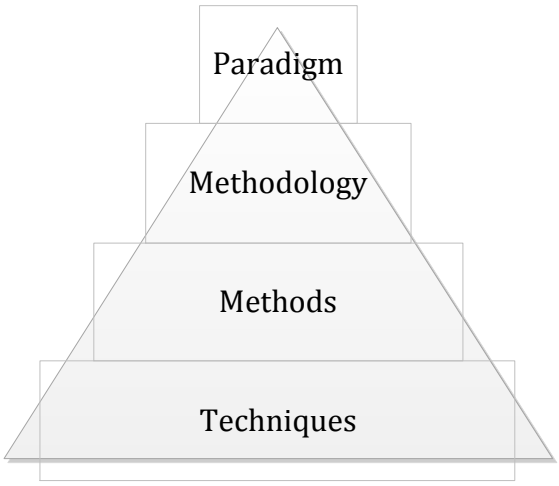

FIGURE 1: THE RESEARCH PYRAMID (JONKER & PENNINK, 2010)

The paradigm level is the starting point of the researcher and the implicit way the researcher approach reality which consists of the limitations set by axioms the researcher considers valid. Defining how we know our reality can be denominated into positivism and constructivism. Positivism holds the view that all true knowledge comes from observing the subject while constructivism is when interacting with it to obtain and evaluate the knowledge. They are both a link between knowledge and methodology (Jonker & Pennink, 2010).

The meaning behind the word methodology is Greek and means "The way along which" and it can be said to be a system of methods and techniques for doing something. Methodology is more a domain than a map and it is there to explain how the researcher has reached his conclusions. Methodology, methods and techniques can be denominated in terms of qualitative and quantitative research. A very basic way of looking these two types is that text information is qualitative and information that is based on number is quantitative (Jonker & Pennink, 2010).

Quantitative information sorts the answers, count them and analyze them statistically in order to provide a solution. Compute processing makes this type of information is easily available today with a very high level of detail and accuracy. This makes quantitative information very valued as it is easy to analyze and to test for validity. For quantitative information to be valid there needs to be a reliable link between reality and interpretation, or said with other words; the numbers should speak for themselves (Samset, 2007).

For qualitative information there are more limitations to ensure accuracy as the reliability can be difficult to confirm. The challenge becomes to ensure the concept is described in such a way that there is no doubt about what is being described. The steps performed for generating the answers in qualitative research can be difficult to replicate. This is due to the researcher's individual interpretation and his closeness to the research topic. Qualitative information is powerful in its ability to be generated quickly and it is our most used basis for communication as well as being fundamental for giving detailed descriptions of complex scenarios (Samset, 2007).

> *It would be nice if all of the data which sociologists require could be enumerated because then we could run them through IBM machines and draw charts as the economists do. However, not everything that can be counted counts, and not everything that counts can be counted.*
> *(Cameron, 1963)*

The quote by Cameron indicates that for information to be useful it needs to be validated. In science validity is used to characterize if information is good or not. Concerns with validity arise when the link between language and the concept described is lacking. Having a goal of making something *better* is not very accurate without describing what that would mean specifically. Inaccuracy is acceptable in the early stages of a project as there is often no accurate information available, but a reliable miss is unacceptable even if the accuracy is good (Samset, 2007).

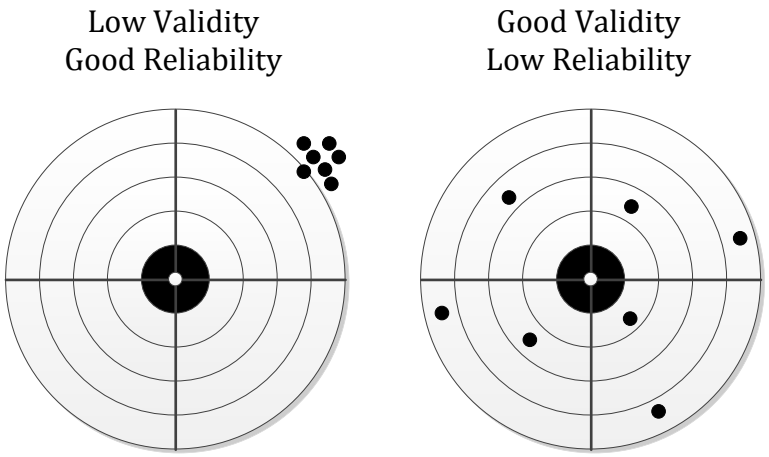

FIGURE 2: VALIDITY AND RELIABILITY - HIT AND MISS (SAMSET, 2007)

Often information is both qualitative and quantitative. Qualitative information helps us describe the big picture while the quantitative information gives the description accuracy. This is the reason qualitative information is primarily used as communication form as it is expected that it is backed up by quantitative information that can be presented if there is a need for it (Samset, 2007).

This report is primarily a qualitative research paper with an approach from positivism, but not exclusively. A major part of the research is related to examining previous research reports on related topics and procedures in Aker Subsea which is a literature study which do not interact with the subject. The minor part of the report has been to analyze the use of SAP in previous projects and interacting with planners.

In addition to this there has been other less informal information channels, such as expert opinions, but it has none the less been valuable. In retrospect this could have been documented better and is a potential weakness to the report. Most of the background material is from documented sources however.

CHAPTER 2

2 THEORY

This chapter sums up theories and concepts that are relevant for this report. There a four main parts of this chapter; Previous research on topics related to ERP and BIM is examined, then processes within Aker Subsea is examined. These two make up the larger part of this chapter, but there are also two subchapters where analyzing how SAP has been used in earlier Aker Subsea projects as well as the relationship between planners and procurers in Aker Subsea.

2.1 ENTERPRISE RESOURCE PLANNING

The birth of ERP Systems started with going from manual accounting on paper, to Inventory Control systems and on to Manufacturing Resource Planning. Inventory Control systems were the first digital tools used to manage the inventory of supplies and goods. Manufacturing Resource Planning is used for production and capacity planning and today it is available within most ERP systems as they are modular so that companies can decide which modules they need for their business. Today ERP Systems are configurable system where a company can store and manage information such as financial, accounting, human resource, supply chain, customer and other information related to a company in a systematic way (Santos, 2009).

SAP AG which is one of the biggest providers of ERP systems was between 1992 and 1997 the world's fastest growing software company in the world. In the 1990s there was an increase in companies embracing the concept of ERP systems and this has been seen as a significant part of information technology history. ERP software applications are basically an interface connected to a database. An important aspect in relation to these systems is not necessarily a technical challenge, but more related to how the ERP systems are being used, as the amount of information stored can make these systems profoundly complex. (Davenport, 1998).

The attraction of an ERP system lies in its ability to have all relevant information stored in one place, instead of being fragmented across many different systems that might have difficulties to communicate with each other. In many cases a

standalone software application might be better than the ERP system at one specific task, but if the information produced by the standalone software application is difficult to use elsewhere then it is quite impractical sometimes. The strength of ERP systems is in the way it integrates many things into one; or the whole is better than the sum of its parts (Davenport, 1998).

The idea behind an ERP system is to have information exchanged automatically with other parts of the system, so when you enter information one place it is reflected other places instantly. Take an example when a customer wants a product that consists of four different materials that each needs to be produced and then assembled. When the order for the product is entered into the ERP system it automatically adds fours orders for the necessary materials, as well as an order for assembling them into the wanted product. The manufacturers know instantly that they should start working and the cost controllers and accountants and management can get key numbers quickly – all from the same system. This is quicker than communicating the information to the four different manufacturers as well as the assembly independently (Davenport, 1998).

2.1.1 CRITICAL SUCCESS FACTORS IN IMPLEMENTING ERP

Implementing an ERP system is a complex task that involves several different departments, disciplines as well as potential changes to how a company works. An ERP system will very often affect the strategy of a company as well as the structure and culture. It is therefore essential to have a broad understanding of the business implications of installing an ERP system. Often the logic of the ERP system is not aligned with the company's procedures and so there can be a clash between system and strategy (Ngai, Law, & Wat, 2008).

There is always the potential for failing to achieve the goal of a more effective company and there have been many incidents reported where the implementation has failed due to several reasons. There has been identified several CRITICAL SUCCESS FACTORS (CSF) for achieving a successful ERP implementation. A company stand a better chance of eliminating or avoiding the most common causes of failure by understanding these CSFs (Ngai, Law, & Wat, 2008).

A study of 48 different articles related to CSFs in ERP implementation 18 different CSFs where isolated and defined as the most prevalent:

- Appropriate Business and IT Legacy Systems
- Business Plan/Vision/Goals/Justification
- Business Process Reengineering
- Change Management Culture and Program
- Communication
- Data Management
- ERP Strategy and Implementation Methodology
- ERP Teamwork and Composition
- ERP Vendor
- Monitoring and Evaluation of Performance
- Organizational Characteristics
- Project Champion
- Project Management
- Software Development, Testing, and Troubleshooting
- Top Management Support
- Fit Between ERP and Business/Process
- National Culture
- Country-Related Functional Requirements

Among these 18 CSFs the 4 most cited ones where "*Top Management Support*", "*ERP Teamwork and Composition*", "*Project Management*" and "*Change Management Culture and Program*" (Ngai, Law, & Wat, 2008).

"*Top Management Support*" was the most frequently cited CSF. Top management must be behind the implementation in regards to resources and involvement. One of the primary responsibilities of top management is to provide employees with sufficient resources and financial support. In addition to this it is also crucial for top management to support the ERP implementation politically. This is imperative in an ERP implementation. An ERP system affects several disciplines and departments in an organization and senior executives are needed to mediate between the stakeholders to resolve political tension related to an ERP implementation. Dedicated members from top management and the implementation team should be in a steering committee that participates in team meetings, closely follow up progress and provide a clear direction of the project as this will ensure the progress goes well (Ngai, Law, & Wat, 2008).

"*ERP Teamwork and Composition*" focus on the team doing the implementation needs to consist of a balanced composition of people with both technical and business competence. They can either be internal from the company or external consultants. In addition to this there is need for a decision maker with enough power for decisions to be initiated quickly and effectively. A vital part of successfully achieving an ERP implementation is a project manager with the ability to manage skilled project members (Ngai, Law, & Wat, 2008).

Complex jobs often require an effective "*Project Management*" organization dedicated to the job and an ERP implementation is a complex job covering hardware, software and organizational issues. A project management organization allows the company to plan, coordinate and monitor progress of the different phases of the implementation. A significant CSF in accomplishing this is to have a detailed project plan with deliverables, milestones, objectives, strategy, scope and schedule. Setting realistic milestone dates for the actual implementation, having

dedicated resources as well as managing expectations were identified as vital parts of project management in ERP implementation (Ngai, Law, & Wat, 2008).

"*Change Management Culture and Program*" can be a bit unclear in its wording, but it has a focus on managing the change on the culture in the company when doing an ERP implementation. If the users of the system are resistant to it then very often the implementation will be unsuccessful as employees end up using the system incorrectly. A central part in making sure users are committed and open to the implementation is to have a focus on training and communication. By doing this they will understand the overall concept better which makes acceptance and eagerness to the ERP implementation more likely. It should be noted that user training will only be effective if business practices and processes is part of the training. This means the company should provide a customized training and educational program which can give the users practical experience in use of the system. It is vital that the program involves realistic and practical case scenarios which give the users a clear understanding of how the new system is different from the old (Ngai, Law, & Wat, 2008).

It is very important for management to look at company processes and the overall organizational environment as dynamic instead of static, as there is a big possibility that they both will change. The processes of the company and the ERP system are mutually dependent on each other which makes it imperative to thoroughly understand both when doing such an implementation. By looking at the entire life cycle of the ERP system there can be valuable information to reflect on compared to only focusing on the implementation phase (Ngai, Law, & Wat, 2008).

2.2 INTEROPERABILITY AND BUILDING INFORMATION MODELING

Making software applications communicate satisfactorily has been a goal of the ARCHITECTURE, ENGINEERING AND CONSTRUCTION (AEC) industry for years and this has resulted in the creation of BIM. The AEC industry has a need for software applications to exchange information and to have a sensible use of it can be a challenge as the systems are not always one-to-one copies of each other. This can make it difficult to define what information should be transferred between the different software applications. This chapter is mainly based on "*Chapter 3: Interoperability*" in "*The BIM Handbook*" (Eastman, Teicholz, Sacks, & Liston, 2008) unless noted otherwise.

Interoperability is the ability to exchange useful information between systems of any kind without the need for human interaction. Interoperability in the context of this report is to automatically exchange data between software applications to eliminate steps and improve the workflow. This type of data exchange is the most common and fundamental form of interoperability. A challenge related to interoperability is to manage the multiple representations of a project. Systems are often heterogeneous and so to make use of the information there is often a need to extract information from one system, modify or add more information to it and then finally import it into another system and make use of it there. It is also often wanted that the process should also be available in reverse. But it can be challenging to fulfill these needs and a survey from 2009 remarks that eight of ten BIM users cite there is a significant need for improvement in interoperability (McGraw Hill Construction, 2009).

BIM is a digital system that uses 3D models consisting of objects and attributes, such as walls and material information respectively. BIM is most commonly used in the AEC industry and these types of projects are team activities that are divided in to several different disciplines, such as architects and structural engineers. Each discipline has their own software applications to help create their deliverables, meaning the architects and structural engineers both use different software applications and they might not always communicate sufficiently.

As changes are done by one discipline several other disciplines need to update their work due to this, and the management of that is fundamental for design coordination.

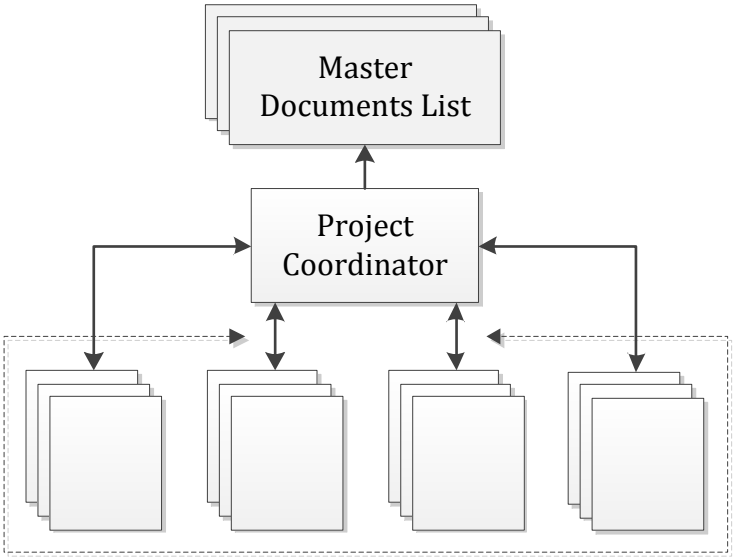

FIGURE 3: THE TRADITIONAL WAY OF MANAGING AEC PROJECTS

The collection of traditional AEC project deliverables is usually a master document list containing technical drawings with supplementary technical specifications from the different disciplines. There are several drawings for one item to represent all the details necessary, in addition to technical specifications when that is needed. When changes to the project occurs each drawing or specification linked and affected to the original change needs to be updated manually by the corresponding disciplines. A project coordinator keeps track of all the changes and needs to keep the project consistent with the latest revisions. It is a task that can be a very cumbersome, but it is none the less very vital. It is usually done manually with specific standardized methods or in some cases by human memory.

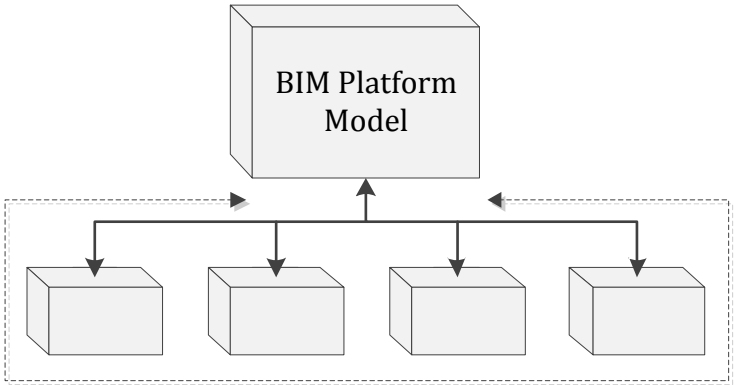

FIGURE 4: THE BIM WAY OF MANAGING AEC PROJECTS

The discipline deliverables with BIM is a 3D model which contains objects with attributes. The attributes are things like identification, coordinates, shape, size, material information and relationships to other objects, with the potential for other relevant information associated to it as well. The different disciplines can work and store their objects in the same model so that project coordination is less cumbersome when implementing modifications and revisions to the project. When a discipline has changed something and saved it to the model it is available for all other disciplines to see immediately.

Technically what happens is that the software applications of the different disciplines extracts their relevant data from the BIM model and rebuilds new model in their own software application. In effect there are several models; one master and several slaves. The discipline-model is one that only has relevant data for that specific discipline in it, but that does include objects other disciplines have created. Structural engineers are for instance interested in spans, loading conditions and beams and this information comes from what the architects added. When the structural engineers has added their changes, the architects needs to review that work to see if everything is alright according to their discipline goals. So the relationship between the different disciplines goes back and forth.

There are however technical and practical limitations to how interactive the work can be. From a technical perspective an object should not be edited by more than one person at a time and from a practical perspective one discipline often works in

an area consisting of several objects at the same time. An important aspect to this is to make sure one object is not edited by two disciplines at the same time, but this can be prevented with a lock-object function. This guarantees that all data has been checked and is consistent up to the most recent timestamp.

Basically the rules of working in an area in real life also apply to BIM, as most often you would not let the different disciplines work in the same areas at the exact same time. To avoid issues with this often there is a responsible BIM coordinator to approve and implement changes to the model manually, but some tools do send the result automatically directly to the master model, such as clash detections and piping changes based on clash detections. As companies and government organizations adopt BIM and use it for code checking and design review it puts an increasingly substantial impact on the requirement of input in the platform model. The requirement for code checking requires classifying objects in the model into classes, such as walls as walls. Automated review-based changes like that are likely to increase, but for now the need for human review is often needed. As the automation of such transactions increase the need for coordinating the different data becomes a requirement. For this the idea is to use a database system, or a BIM-repository, where project related data can be stored and coordinated to help manage the synchronization of multiple models used in the project to such a degree that it can be seen as a portfolio of models and information.

If synchronization is to be realized at the object level then automatic methods will have to be implemented and relied upon. A method for doing this is a framework that ties object together with global unique identifications and timestamps. This makes it possible for tools to identify object, regardless of tool and makes it clear which is the last revision of that object.

Standards are essential when it comes to interoperability. There are several organizations working on creating BIM standards specifying the data required for data exchanges. Open BIM is an initiative of buildingSMART International and several leading software vendors using the open buildingSMART Data Model where the goal is to create a universal approach to the collaborative design, realization and operation of buildings based on open standards and workflows. The idea is to have transparent and open workflows in one common language to allow discipline to contribute from any software application they prefer as well as higher quality of data in the project. This way there is no need for multiple inputs of the same data and avoidance of the errors related to such (buildingSMART, 2012).

The tools used for building design are digital and so the standards developed by computer scientist to handle interoperability are computer languages like XML and others. These languages are then the basis for file formats that can contain the information that make up the model. There has been a big focus on creating open file formats instead of closed proprietary governed by one single software application vendor. One such open file format is IFC developed by the international non-profit organization buildingSMART. IFC is used by several software applications as their main file format and most BIM software applications support it in some way either by import, export or both.

The architects and engineers working with the tools however are the expertise on what the exchange content should be. Interoperability is basically mapping specific data fields from one system and linking it with the logically consistent field in another system. In some cases the systems are logically identical and does not require a change other than the link, but in more complex situations data have to be split up and moved into different fields based on how the systems interprets the information. By the time a building is completed there have been numerous such translations and exchanges and it is done by moving information from data fields in one system over to another, either by splitting it up into different fields or transfer it directly to one specific field. It is very common to use several different

software applications to fill all the needs of the company instead of using one single platform because it is more resilient to obtain interoperability than making all disciplines work on the same platform. Interoperability touches on the concept of managing lean workflows as it has moved from strictly data exchange to eliminating steps and improving workflows related to the operation of data exchange.

When looking at the similarities and difference of BIM and ERP there are some interesting aspects to examine. ERP systems deal mainly with the management of manufacturing and service enterprises in a wide area of industries, while BIM is focused mainly on the AEC industry. Both ERP and BIM are information systems that are part of a network of integrated software applications that derive most of its value from data integration. ERP origins are linked to the planning of manufacturing processes, but its great success is the additional integration of accounting, financial management and analysis modules to other administrative areas of a company. It is clear that ERP and BIM are two different concepts with separate functions, but they are both systems with a broad scope on the organization. By comparing and analyzing these systems to identify their similarities and differences it is possible to use that to benefit both systems. BIM certainly face many of the challenges ERP has gone through and in addition to this it is possible to look at how BIM has solved some of these challenges separately it is possible to use similar approaches towards ERP development (Santos, 2009).

ERP lineage	BIM lineage
Manueal paper-based accounting	Manual paper-based drafting
Inventory control (IC)	2D CAD
Material Requirement Planning	3D CAD
Manufacturing Resource Planning	Parametric CAD
Enterprise Resource Planning	4D
Extended ERP	5D
	nD
	BIM

TABLE 1: THE HISTORIC EVOLUTION OF ERP AND BIM (SANTOS, 2009)

CHAPTER 3

3 CASE: AKER SUBSEA; PLANNING & SCHEDULING

Aker Solutions ASA is a Norwegian company in the ENGINEERING, PROCUREMENT & CONSTRUCTION (EPC) industry providing services to the international oil and gas industry. The headquarters are located in Oslo, but the company operates worldwide in Africa, Americas, Asia Pacific, Europe and the Middle East.

FIGURE 5: AKER SOLUTIONS LOCATIONS IN THE WORLD (AKER SOLUTIONS, 2010)

The history of the company can be traced back to two small Oslo companies in the 1800s; Akers Mekaniske Verksted and Kværner Brug. Akers Mekaniske Verksted was a mechanical workshop which later shifted its focus towards shipbuilding. Kværner Brug was an iron foundry producing stoves and tools related to households and farming which later focused on mechanical tools and machines. The two companies expanded and grew on their own up until 2002 when a merger between the two became Aker Kværner, which again changed its name to Aker Solutions in 2008. Today Aker Solutions is a company that employs approximately 23 500 people in more than 30 countries (Aker Solutions, 2010).

Aker Solutions is the name used officially towards anyone outside the company, but within the company it is divided in to several fractions. This report is written within Aker Subsea and Figure 6 displays the structure of the company relevant for this report, but it should be noted that the group has several branches and so does each level below that again.

The integration project is initiated by P&S. In this sub-department there are mainly planners working with SAP and Primavera. Another involved Business Area is Aker Business Services which approve IT services implemented, such as the integration project.

FIGURE 6: COMPANY STRUCTURE (AKER SOLUTIONS, 2008)

The structure of a project is divided into engineering, procurement and construction, which all have their respective disciplines who all have their specific deliveries. Project teams are populated by members from the different discipline departments and most project team members are assigned to the project for the entire duration of the project. For managing the projects Aker Solutions has their own developed Project Execution Model (PEM) which is a phased approach to project execution and there are detailed procedures related to each discipline.

A CENTER OF EXCELLENCE (CoE) is a department within the company that deals specifically with one topic and specializes in that. The primary function of the Planning & Scheduling department is planning and scheduling and has a secondary function as the CoE for that topic. Other departments that have planning activities as a secondary function can then contact the planning and scheduling CoE if they need guidance or training with planning and scheduling.

3.1 PROJECT EXECUTION MODEL

Aker Solutions Project Execution Model (PEM) is used for all projects in the company and is a phase structured approach to project execution. It is implemented from the beginning of the tender stage and applied through all the project phases to ensure consistent project execution performance. The project execution methodology is based upon the industry recognized operational practices of "*Project Management Institutes*" (PMI) "*A Guide to the Project Management Body of Knowledge*" (PMBOK Guide) as well as the experiences, best practices and lessons learnt from previous projects. PEM also provides the methodology for early identification and continuous monitoring of the projects risk and opportunities (Corporate Project Execution, 2012).

There are three different levels of PEM in Aker Subsea.

1. Strategic
2. Control
3. Execution

The strategic level shows the life-cycle of a project in a sequential and logical manner with five standard project execution phases. The Tender & Kick-Off phase is always the first phase and helps define the scope of delivery of the project including the quality of information available at project start-up. The phases describe at a high level the sequence of work required to deliver a project. Detailed phase descriptions may vary according to project type. The phases are divided by milestones. Each milestone identifies the tasks that have to be done, achieved or completed at that time in order to progress to the next phase. (PM&C PEM Milestone Gate Review, 2011).

The Control Level is the second level of PEM and at this level the phases of PEM are further split into stages where each stage has defined objectives with focus on coordination between disciplines and requirements to and from other project activities. Exactly like the milestone in the strategic level, the control level requires that critical milestones of a stage have been met or have been accounted for, prior

to moving to the next stage. The project work in each phase shall in principle go through the project management cycle involving initiation & planning, execution & monitoring and controlling & closing before continuing on to the next stage (Corporate Project Execution, 2012).

The execution level is the third level of PEM. It is Business Area specific and contains the multidiscipline work processes required to execute a project. This level provides documentation used to define the deliverables throughout each stage of PEM, and demonstrates the logic and sequence of work that forms the basis for defining the project schedule and scope of work. There are specific flowcharts, activity description sheets, checklists, procedures and templates to help with this (Corporate Project Execution, 2012).

PEM also has three modules:

- Project Tendering & Studies
- Project Management
- Project Execution

Each module contains key activities, deliverables and processes to be carried out related to their knowledge area. Project Tendering & Studies is tendering and studies related, Project Management is process related and Project Execution is discipline related.

A short overview of the stages that are in the phases of PEM as well as the correlation between modules and phases can be indicated in Figure 7: Relationship between Phases and Modules
and below.

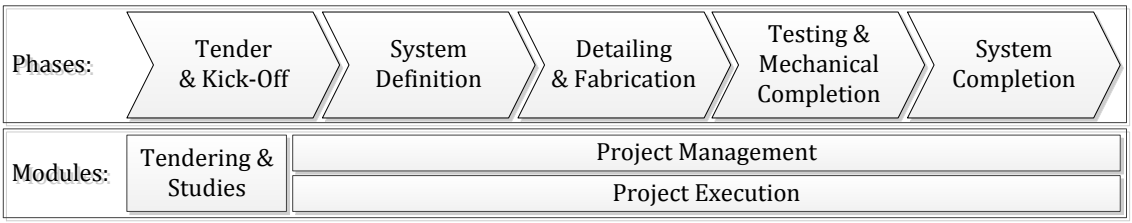

FIGURE 7: RELATIONSHIP BETWEEN PHASES AND MODULES (CORPORATE PROJECT EXECUTION, 2012)

1. Tender & Kick-Off
    a. Assess
    b. Prepare
    c. Approve
    d. Negotiate
    e. Handover & Project Start-up
2. System Definition
    a. System Definition
    b. System Design & Layout Development
    c. Global Design
3. Detailing & Fabrication
    a. Detail Design & Subcontracting
    b. Pre-fabrication & Manufacturing
    c. Assembly
4. Testing & Mechanical Completion
    a. Testing
    b. System Integration Test
    c. Mechanical Completion
5. System Completion
    a. Mobilize
    b. Commissioning
    c. Demobilize
    d. Close

3.2 THE PHILOSOPHY OF TIME MANAGEMENT

All Aker Subsea projects use a common planning and scheduling philosophy. This is to achieve similar scheduling analyses and deliverables for all projects. Aker Subsea follows to THE ASSOCIATION FOR THE ADVANCEMENT OF COST ENGINEERING INTERNATIONAL (IAACE) Best Practices and it serves as a basis for the principles applied in the Aker Subsea Unit. The goal is to deliver realistic schedules with low to medium risk unless otherwise specified by top management (P&S Governing Procedure, 2010).

A schedule analysis usually consists of CRITICAL PATH METHOD (CPM) analysis, time discrepancy and progress. The primary goals of updating schedules, progress measurement and manpower forecasting is to advise the project team in regards to delivery dates to each discipline, certainty in the dates provided and the need for corrective actions if there are issues (P&S Schedule Analysis, 2010).

The objective of measuring progress and reporting it to the project management team is to identify issues that can impact the schedule so that the underlying causes can be mitigated or resolved as well as to ensure that resources are effectively applied to critical activities. This should be communicated to the project management team in written and verbal form in project meetings, but also as urgently as possible when the delays are critical. The planner will analyze the schedule on critical activities to determine potential consequences from deviations. (P&S Progress Measurement & Reporting, 2010).

Critical activities are activities on the projects critical path. The planner should always review the delays that are detected in the engineering and procurement schedule activities that will directly affect construction. The engineering, procurement and construction lead engineers are accountable for the dates they provide to the planner and expected delays should be communicated to them by the planners (P&S Schedule Analysis, 2010).

The deliverable of the planner is to provide a realistic schedule that is can be analyzed by use of the CPM. This method will highlight critical areas in the

schedule and based on this the planner will provide guidance for making decisions in a project. The planner has an obligation that goes beyond reporting responsibilities. An important action is to gain an understanding of what are the problem areas in the project, why it is a problem and what is the possible solution to the problem. This gives strategic importance to the effective communication of results provided by accurate reporting and analysis (P&S Governing Procedure, 2010).

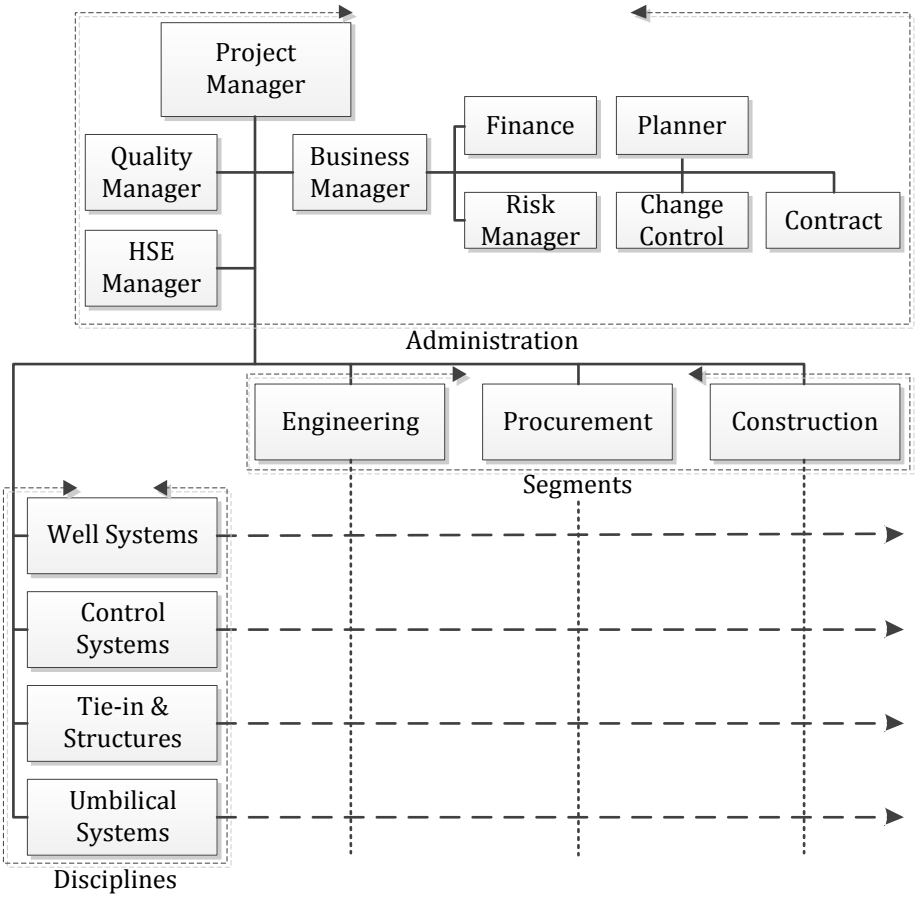

FIGURE 8: PARTS OF TYPICAL AKER SUBSEA PROJECT ORGANIZATION (PM&C PROJECT START-UP, 2008)

3.3 TIME MANAGEMENT SPECIFICS

There are five main areas for establishing and maintaining realistic project schedules that monitor and control a project in regards to time management:

1. Establish Time Management Plan
2. Establish Draft Baseline
3. Finalize First Baseline
4. Baseline Revision
5. Monitoring and Control

The objective of the time management plan is to provide a basis for how the project time management will be executed in a project. It is based on the initial scope that is in the signed contract (PM&C Project Start-up, 2008).

The draft baseline should include a description with how the plan is built up, assumptions, risks related to time and other important elements. The tender schedule is the basis for the draft baseline which later becomes the first baseline. It is important to prioritize the level of detailing early activities while later activities can remain less detailed. Often the details are not known when establishing a draft baseline so the draft schedule will not have all detailed information, but new details will be added to the schedule as soon as the information is available (P&S Scheduling & Baseline, 2010).

Once the project has defined and established the layout and structure the planner should start to prepare for a baseline revision. As the projects progress there are more revisions at specific milestones. The idea is for the project team to work with an updated and realistic schedule at all times with changes and necessary level of detail merged in as they are discovered (P&S Baseline Revision, 2010).

Two important aspects of planning are monitoring and control. The first is to monitor the dates and progress for all activities in the current schedule. This also includes reporting progress development with Bar-charts, S-curves as well as presenting CPM analyses. The second is performing CPM analyses for forecasting

on critical activities and determine consequences if corrective actions are not implemented (P&S Activity Description Sheet, 2011).

Time Management is integrated and closely associated with other project control processes such as scope and change control, risk management, cost estimating and control, man-hour registration, and work productivity. Further, time management interfaces technically with engineering, procurement, and construction management (P&S Governing Procedure, 2010).

3.4 SAP & PRIMAVERA

SAP is Aker Solutions selected software application for their ERP system. Sap is delivered by the German software vendor SAP AG and the history of SAP started in 1972 by five former IBM employees who wanted to create software applications for real-time data processing. The company is headquartered in Germany and today SAP is the market leading software application for ERP systems with 40 years' experience, nearly 50 000 customers and delivering solutions to 25 different industries. The goal of the company is to produce enterprise software applications that enable companies to operate profitably, adapt continuously, and grow sustainably (SAP, 2010).

Primavera is a software application developed by Oracle to help manage the lifecycle of projects or a portfolio of projects of all sizes. An estimation made by Oracle says Primavera has been part of managing projects worth $6 trillion in total. It manages cost and time with an added module for risk related to both. In addition to this it functions as a report generating tool for S-curves and Gantt-diagrams and has the ability to easily analyze the plan with different scenarios (Oracle, 2011).

It is the Planners responsibility to do the following in regards to the establishment of the schedule (P&S Knowledge Area Description, 2011):

- Create WBS
- Define activities according to PEM.
- Sequence activities logically
- Estimate activity resource needs
- Estimate activity durations
- Add dates to schedule.

When a contract is won a project number is established in SAP and the project is ready to be set up by the planner by building the WBS structure and adding network and activities. The WBS structure reflects the planned Bill of Materials and assembly in addition to the actual discipline deliveries. This means the WBS elements follow a specific pattern in regards to who makes what and where they do so. Primavera does not have networks and so there is a slight misalignment with SAP in that regard, but SAP do not link activities together logically. The difference is due to how the systems are used. SAP use networks for production related issues and Primavera use links for scheduling related issues.

Level	SAP	Primavera
1.	WBS Level 1	EPS
2.	WBS Level 2	Project
3.	WBS Level 3	WBS Level 1
4.	WBS Level 4	WBS Level 2
5.	WBS Level 5	WBS Level 3
6.	Network	-
7.	Activity	Activity

TABLE 2: SAP VS. PRIMAVERA STRUCTURE (P&S PROJECT WBS & CODING, 2010)

Activities are PEM based and should be aligned with Primavera. When the WBS structure, network, and activities are established the project scheduling can begin. Dates on activities are the driving force and there should be start and finish dates for each activity. These dates should be aligned one-to-one with Primavera so if there are changes then dates in both systems needs to be updated. There are three types of activities in SAP:

1. Internal Activities
2. External Activities
3. Cost Activities

Internal activities are activities that are done by Aker Subsea and it needs to be defined which work center will perform them and an estimate of how many hours the work will take. The cost is then calculated based on a rate linked to the activity type on the work center. These activities can be split into administrative internal

activities or non-administrative internal activities. The start and finish date and duration related to the former usually run from project start to project closure while the latter is agreed upon together with the responsible discipline. Planned hours on the activities using these work centers multiplied by planned rate should equal the administration and preliminary budget for the project, while planned hours on the activities multiplied by planned rate using these work centers should equal the engineering budget for the project.

External activities are for activities that will be done externally by a sub-contractor. Who needs it and at what date are located here as well as price, which person in Aker Subsea actually bought it and from what external sub-contractor. External activities are usually by the manufacturing leads, but the planners should be notified.

Cost Activities are activities for additional costs such as travel or team building. Here the cost amount, duration and cost element are important.

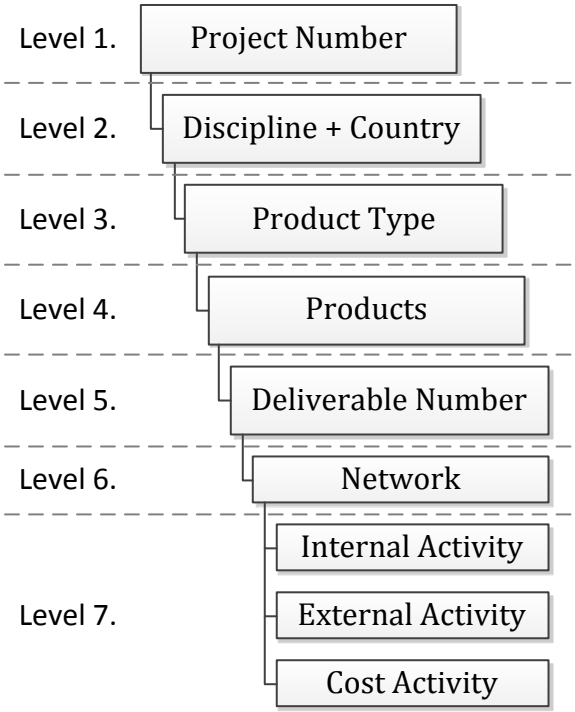

FIGURE 9: SAP PROJECT STRUCTURE IN AKER SUBSEA (P&S SCHEDULING & PLANNING IN PRIMAVERA, 2010)

After a new project has been created a document milestone chain must be set up which enables the project engineers to insert forecasted start and finish dates and report progress on documentation. This is critical as no progress may be reported until this happens. This means the engineers decide the start and finish date of engineering activities and this can be a challenge sometimes. The work the engineers do not focus much on these dates and since they decide the dates then sometimes the date on the activity is disregarded. The problem with this is that the planners are not notified early enough or at all.

SAP	Primavera
The internal system linking all products deliveries at a detailed level and mainly serves the purpose of: • Engineering documentation workflows, estimation and progress tracking; • Order reservation estimation, progress tracking and reporting; • Fabrication and testing estimation, progress tracking and reporting; • Reporting tool for internal financial reporting; • Invoicing and other financial analysis.	The integrated scheduling and planning tool serving the following purpose: • Baseline (legal document) for detail planning in SAP & client reporting; • Schedule analysis for internal time control; • Progress reporting tool; • Basis for schedule risk analyses (time & resource based).

TABLE 3: SAP AND PRIMAVERA MAIN PRINCIPLES (P&S GOVERNING PROCEDURE, 2010)

The planned hours assigned to a document shall reflect all work needed to complete the document. The actual posting of hours should be executed on the activities to where the documents lie so that it is possible to compare planned hours against actual hours. This helps in preventing cost over-runs for the activities and also assists the tender department by providing valuable and usable historical data for future tenders. The sum of planned hours assigned to the activities should add up to the total man-hour budget for the discipline, and also within the different engineering activities in SAP.

To ensure correct progress reporting it is crucial that the following is checked and confirmed by the planners:

- All documents are connected to correct activity.
- All engineering activities have documents are attached to them.
- Document dates are within activity dates.
- Planned hours per document are realistic.
- Progress tracking dates are in the correct order.

Each project contract specifies a progress chain to be used for the documents. When a document on an engineering activity is checked and approved by other disciplines it reaches a certain percentage of complete and this is also the percentage complete for the whole activity. The overall project progress is measured on the basis of these progress chains.

Description	Code	Percent Complete
Start	Start	10%
Internal Discipline Check	IDC	60%
Client Review	CR	80%
Issued for construction	IFC	100%

TABLE 4: DOCUMENT MILESTONE PROGRESS CHAIN (P&S SCHEDULING & PLANNING IN SAP, 2011)

Activities will be updated throughout the Project, and therefore the material requirement dates needs to be evaluated. These are the dates related to procurement and construction and it is their responsibility to notify about changes to these dates. All planned major purchase orders will be identified with their corresponding activities in the schedule. The manufacturing activities are planned according to the production orders in SAP (P&S Progress Measurement & Reporting, 2010).

Actual progress in engineering, procurement and construction is measured according to milestones of the physical complete status of the delivery. Engineering deliverables are documents, while procurement and construction deliverables are usually a material or complete product.

Any variation orders shall be added to the project plan as soon as they have been approved by both client and Aker Subsea. Planners must update the project plan as necessary as this could have effects on the project finish date. Actions should be discussed and agreed upon with the Project Management (P&S Change Order Handling, 2010).

As the procedures specify how things should be done it would be interesting to see how the state of SAP actually was. Key Performance Indicators (KPI) that would provide information about the quality of information in SAP were identified and measured. The result can be seen in Table 5 and is an indicator that the use of SAP is not as good as it should be.

Key Performance Indicators	
How many activities in SAP do not have planned duration?	90%
How many activities in SAP do not have planned hours?	88%
How many activities in SAP have cost overrun compared to planned hours?	80%
How many dates on documents are outside the date on the activity?	73%
How many documents ongoing in SAP do not have planned dates?	15%

TABLE 5: KPI RESULT FROM SAP

CHAPTER 1

4 DISCUSSION

The chapters on Theory and Case lay down the foundation for what is discussed in this chapter. It is structured in to two parts where first defines the system definition of it is discussed how the implementation of the integration can be done successfully and the second structures what Inspire should base itself on.

ERP systems are modular and this is the reason for discussing ERP implementation when Aker Solutions already got an ERP system in place. When implementing ERP systems it can either be done by implementing all modules at once or module by module when implementing one module at the time. SAP is currently lacking a viable module in terms of planning and scheduling, so integrating SAP and Primavera is in this context regarded as implementing a new module to SAP. This means the issues and research related to implementation of ERP systems are also relevant for this project and report.

Another aspect of ERP is that some aspects of BIM can be traced back to the concept of ERP systems. Both systems collect a lot of information and try to make use of it in a systematic and effective way. Research on how BIM can benefit from ERP has been conducted (Santos, 2009) on the grounds that the errors and issues that ERP went through back in the day can be avoided by BIM if known about. But ERP and BIM are not finished in terms of development so investigating both ways can potentially be beneficial.

4.1 SYSTEM DEFINITION

The system definition should include information about the system definition, the system design & layout development and the global design. It is the rough edges where the details can be filled in. As this is the project start the administrative and defining who does what tools needs to be established.

4.1.1 WHAT IS THE RELATION TO BIM?

The foremost resemblance between BIM and the integration of SAP and Primavera is that both have a goal for software applications to exchange information with each other without the need for human interaction. Both have evolved from fragmented software applications to become systems where interoperability is the foundation. There are technical differences between the two, but on the concept level makes the comparison relevant and the potential for gaining knowledge is present. The reason for companies to choose to implement these systems has been to trade capital expenditure against improved and more effective workflows which results in higher profitability. Increased use and availability of technology has made them both relevant and difficult to do without.

In regards to system definition it is important to describe how these systems basically function. The core concept is to have one system where everything is stored and available for the relevant users. By simplifying it into one master and slave system it is easier to visualize. The master system has all the available data. The slave system then extracts the data it needs and puts it back together in a sensible form. This extraction and rebuild process can include a modification to the extracted data by automatically adding new information to make use of it in the slave system. When the slave model then is rebuilt it is ready to be manually modified by a user. After the manual modifications have been done to the slave model it is ready to upload the wanted changes in to the master model again and that is the basic process of it.

If it is wanted to have information go both ways, one way of doing this is to just switch who is master and who is slave at some point. An expansion of that thought

is to break the concept of master and slave down into smaller pieces. Then it is possible to create quite complex information exchanges between two systems. As indicated in Figure 10: Systems Within Systems a data field can be master in one system, while another data field can be slave in the same system.

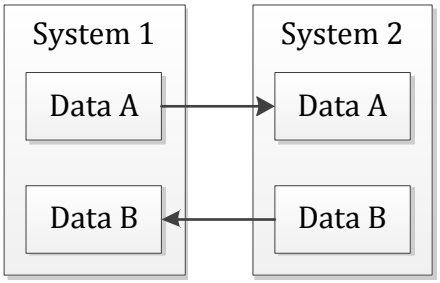

FIGURE 10: SYSTEMS WITHIN SYSTEMS

For BIM or ERP this means that certain objects or dates can be overwritten while others will remain the same, depending on the configuration. From a technical point of view the configuration is more or less the same; a simple "yes" or "no".

Now that the core concept is described what does that help? In the integration project SAP will in most cases function as the master system as this is where officially the information should be stored.

As the field for field mapping phase has not yet have begun it is difficult to tell at this point if there will be scenarios where Primavera should have priority over SAP. Inspire will in theory collect information from SAP and put it into Primavera based upon a configuration table configured by an external IT firm.

That does not mean Primavera will not be used. By looking at the P&S procedures there are certain topics of interest in regards to system definition. The goal is to work according to PEM and these procedures and this should be reflected in the transfer of data. After a project number has been allocated in SAP, there are four actions to be done in SAP and Primavera for Time Management:

1. Establish Draft Baseline
2. Finalize First Baseline
3. Baseline Revision
4. Monitoring and Control

Today the Draft Baseline is established and finalized in Primavera before anything more happens in SAP. Primavera is more resilient and friendly when there is a need to make changes, which happens quite often during a draft. The duration from draft to first baseline is often somewhere between 30 to 45 days depending on the project, but in this time employees need to post hours and upload certain documents to the project and it is not an option to not post hours or upload documents.

A perfect scenario would be to work on the baseline in Primavera until the baseline is complete and can be transferred to SAP. This creates a problem where engineers and what not needs to post hours and upload documents. A counter to this issue would be to create a template of activities in SAP on day one. The template can be generated by analyzing several previous projects and see what type of activities have hours posted to them and documents uploaded during the drafting period. If there are activities that are present in each of those project that fits the criteria then those can be the template. It is always possible to add an activity extra during the drafting period if the project does not fit the standard of course. Another solution is to create two dummy activities, one for hours and one for documents. These should then only be used between project start and first baseline. When baseline is delivered documents should be moved to the activities they belong in and both activities needs to be closed. This is the solution that is the least messy, after the cleanup has happened. The template has the potential to create activities that are not being used throughout the project at all as nothing should be deleted within SAP if it first created there.

When the first baseline is finalized in Primavera it should be transferred to SAP. Information will then come from engineering, procurement and construction in SAP and over to Primavera where it is monitored and controlled. This happens up until it is time for a Baseline Revision, which happens much the same way as the drafting does, but without the need for dummy or template activities.

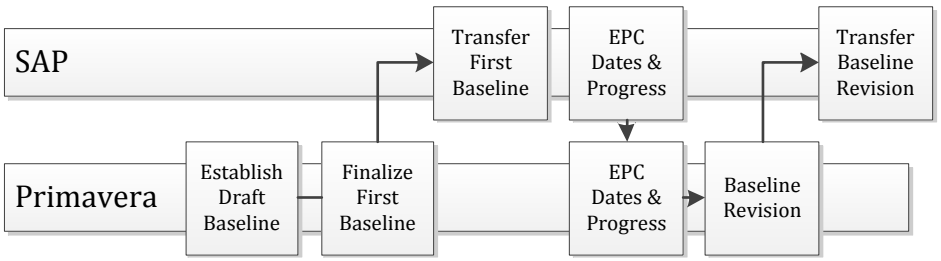

TABLE 6: INTEGRATION SYSTEM DEFINITION

4.1.2 WHAT ARE POTENTIAL PITFALLS?

There are some troublesome issues to look out for. As Table 5 indicates in regards to KPIs from SAP, of activities that has documents with dates attached to them there are 73% of them where the date on the document is outside the date on the activity. The problem here is that the date on the activity is the one that is in the schedule, while the actual delivery will be delivered later. When transferring the activity date from SAP to Primavera the schedule will be wrong.

Another issue is that procurement is vendor based, meaning they get a list of materials they need buy from several projects to focus on cost savings by buying a lot from few vendors. Questionnaire sent to planners regarding procurement indicate that procurement is not involved with the projects enough and do not have enough incentives for updating SAP. As they are the ones providing the dates for the procurement activities and it if it does not exist in SAP then it will not be available for transfer either.

In regards to construction there does not seem to be too may issues. It is similar to Engineering as it is an inside job, but there are less deliverables.

A risk covering the whole concept relates to how letting information go automatically there is no intelligent check in regards to errors. This means that if the system is not resilient in handling flawed input then the consequences can create more work than not implementing the integration software application. In other words; if the project is unsuccessful then it could potentially decrease Control, Predictability and Profitability for Aker Subsea.

4.2 PROJECT EXECUTION

Back in 2007 there was a need to make P&S more effective and involved in projects. The possibilities of integrating SAP and Primavera was examined, but it was decided by top management to wait as the sub-department needed a more stable and defined structure. Between 2009 and now P&S has developed into a highly effective tool for project management and control. It is the CoE for planning and scheduling in Aker Subsea, which gives an indication of the level P&S operates at. It should be noted that Aker Subsea has planning departments all over the world at their different locations.

When implementing an ERP system it has been mentioned that the project team and its project manager is a very important aspect. The project team should consist of members with both technical and business competence. Aker Solutions has available resources in both areas. The technical competence is divided into two camps. One camp is the external IT firm doing the actual programming and the other is the IT department of Aker Solutions which approves all the IT services implemented in Aker Solutions. Both have vast knowledge of why and how the software applications work. The business competence consists of the senior planning engineers in the sub-department. These employees know how to use the tools, and most importantly, how to use them in a planning and scheduling setting. Together they have decades of planning experience and they know the company procedures by heart.

The project team consists specifically of one project manager with experience from planning, Primavera, system integration and project management. In addition to this there is one SAP specialist and one planner. To make the team complete there is also a technical IT consultant who was brought in to assist with the technical aspect. It should be noted that there are other people associated with the project as well, but not to the magnitude of these.

One important aspect is of course the project team and their competence on the industry and the software applications. Another just as important aspect is the

third trade involved; project management. Luckily for this project P&S is very skilled and experienced with project management on a high level. It is imaginable that a project team with experience from a less project oriented industry can face bigger difficulties in regards to this. Creating a detailed time management plan that highlights the time schedule, deliverables, milestones, objectives, strategy and scope, in addition to following this up has been high on the agenda from project start-up. A steering committee of six people has been established headed by P&S manager and consisting of senior executives, SAP and Primavera specialists as well as other project management and control employees. There are regular meetings with the steering committee for reporting progress and to clear any uncertainties.

The integration project has been part of a long-term goal in Aker Subsea, but it has been dormant on the agenda for quite a while. Now that investigation into how it can be implemented has resulted in substantial financial funding and been mentioned in company forums by relevant senior executives to Aker Subsea. It has been presented as a significant addition to the company and something there is a clear need for. Top management is supporting the project financially, with resources and politically, which is one of the identified critical success factors.

This was already in place before this report was initiated, but a noteworthy issue about it is that it corresponds with CSFs for ERP implementation identified earlier in this report (Ngai, Law, & Wat, 2008).

An important CSF identified was the need for training and preparation for culture change. It is expected that the action of other employees will have a direct effect on the schedule when the integration is implemented. If an engineer uploads a document with an unverified date then that will directly affect the related activity without approval of the planner. The planner will see the plan has changed and will either contact the engineer directly, or flag it to the project management team. The consequence is that the responsible engineer is more likely to be notified about the wrong date and fix the problem. If wrong dates happens often then the communication between planners and the project management team will reach proportions where it can affect the project negatively and go into the lessons learnt

database. From there it will find its way in to PEM which will hopefully change the procedure of the engineers and the final consequence is either way increased quality of information in SAP and in the schedule

The project is still early in the development as the system definition of the Engineering phase is still being discussed internally. There are two issues with this. The external IT firm has already delivered a draft with details regarding the engineering phase, but it was based on a system definition that was not completed yet. Moving on to another phase before specific goals have been completed should not be done. It is possible to debate that this was a quality check, but it is still not according to PEM and it is not money well spent.

4.2.1 IMPLEMENTATION SUMMARY

Aker Subsea is operating in a highly project oriented industry and have well defined procedures and tools for doing this. The way Aker Solutions do their projects is aligned with current industry standards (Project Management Institute, Inc., 2008) and it is structured so that it is possible to use PEM for projects of any size. The employees within Aker Subsea and especially P&S that will be involved in the implementation project are used to PEM and will feel familiar with the structure an layout of it, which is also one of the objectives of PEM. This means it would be both possible and wise to use PEM for implementation of the integration project. Aker Subsea projects are divided into segments of engineering, procurement and construction. As these segments are handled by different departments and other modules in SAP it is considered sensible to divide the system definition of the project into three separate segments; engineering, procurement and construction.

See Table 7: Phases of the Implementation for recommendation:

Phase	Description	Status
Tender & Kick-Off	Find a software application to do the integration and an IT firm to do the modifications.	Finished
System Definition	First part of this chapter	Ongoing
Detailing & Fabrication	Define what data fields are transferred between SAP and Primavera as well as the actual programming and modification needed.	Not Started
Testing & Mechanical Completion	Testing Inspire in a closed environment as well as fixing errors discovered during testing and prepare training manuals and courses.	Not Started
System Completion	Roll out to the live SAP and Primavera systems.	Not Started

TABLE 7: PHASES OF THE IMPLEMENTATION

CHAPTER 5

5 CONCLUSION

For the integration of SAP and Primavera to be implemented successfully there is a clear need for a well-functioning project management team. This team needs a powerful and knowledgeable project manager as well as team members who got the relevant technical and business background related to the topic of the project. This project and the team also need resources, financial and political support from the top management. When the integration is in place and the user of SAP and Primavera, the planners, start using it they need to be trained in how to use it. Without the proper training the whole implementation will be unsuccessful.

That information is derived from related research on similar topic. The fact that ERP systems are modules and modules can be seen as standalone software applications makes an integration project an installation of a new module. From this statement all previous research into ERP implementation can be valid information to benefit this integration.

As BIM and ERP systems are similar in many ways there is also an abundance of research on BIM that can benefit ERP. It is likely that interoperability between ERP systems and BIM will at some point be wanted by many. A reason for stating this is when analyzing the background on the AEC industry and BIM it is obvious for everyone to that when the door to interoperability was opened it not only made 3D models and attributes a possibility, but also many other dimensions such as time and cost.

When integrating SAP and Primavera in Aker Subsea it is relevant to transfer information related to time and progress. Time, to create the schedule and progress, to make the schedule reliable.

The expected outcome of the integration on the organization and the culture is a higher quality of information available and that planners will have more time to analyze the schedules and deliver more reliable schedules as a result of this.

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APPENDIX

A. QUESTIONNAIRE TO PROJECT PLANNERS IN REGARDS TO PROCUREMENT.

This questionnaire was sent to planners after a meeting where it was indicated that it was troublesome getting useful information from procurement.

How is the feedback from Procurement?

Is there any feedback provided at all?

If yes, do you trust it?

How much time do you spend searching for information that procurement should provide?

What would you change if you could and is there a better way forward?

What do the Progress Reports lack?

Are the current reports sufficient?

If no, what is missing?

Any other feedback in regards to communication between Planning & Scheduling and Procurement?

The results were then presented to procurement as a foundation for a better synergy between the departments. It was established that procurers was getting a lot of planners calling them for information, but this is not the correct communication channel and was disturbing for them.

It was also established that the procedures wording of "necessary information is to be provided to project planners" was insufficient. The result was to have more streamlined reports & systems handled by procurement.

B. Overview of Project Planning in SAP