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## Abstract

This study investigates the impact of participation in collaborative research- and innovation activities for SMEs and MNCs, and how they respectively engage with such activities. A survey is performed on a non-random sample of 42 participants in research and innovation projects, and further supplemented with three depth-interviews of a subset of survey participants. Key findings: SMEs benefit from technology-related activities, while MNCs benefit from business-related activities as well. Heavy-handed bureaucracy in projects is a major point of friction for SMEs. Both SMEs and MNCs view the establishment of relationships with the other partners as valuable in terms of unrelated business opportunities. The collected data has not been exhaustively analyzed, which could also provide further research opportunities.

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## Sammendrag

Denne studien undersøker virkningen av deltakelsessamarbeidende forsknings- og innovasjonsaktiviteter for SMBer og MNCer, og hvordan de henholdsvis engasjerer seg i slike aktiviteter. En spørreundersøkelse gjennomføres på et ikke-tilfeldig utvalg av 42 deltakere i forsknings- og innovasjonsprosjekter, og suppleres videre med tre dybdeintervjuer som utgjør en delmengde av undersøkelsesdeltakere. Nøkkelfunn: SMBer drar nytte av teknologirelaterte aktiviteter, mens multinasjonale selskaper i tillegg drar nytte av forretningsrelaterte aktiviteter. Tunghendt byråkrati i prosjekter er et stort friksjonspunkt for små og mellomstore bedrifter. Både små og mellomstore bedrifter og multinasjonale bedrifter ser på etableringen av relasjoner med de andre partnerne som verdifull, med tanke på ikke-relaterte forretningsmuligheter. De innsamlede dataene kan også danne grunnlag for videre forskning.

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## Preface

This article is a deliverable in the course *TIØ4912 - Strategy and International Business Development, Master's Thesis* at the *Norwegian University of Science and Technology*.

I would like to thank my supervisor, Per Jonny Nesse, for his help during the semester.

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# 1 Introduction

Based on a previous systematic review Opsahl, 2021 of relevant literature, a research gap was identified on the topic of the SME perspective in collaborative research and innovation projects. The literature review was initially concerned with the usage of *Lean Startup*-methodologies in the context of open innovation Ries, 2011, but also looked at its role in *triple helix*-ecosystem Carayannis et al., 2021. During the process, a research gap pertaining to the interaction between SMEs and collaborative innovation activities was identified. Though some research exists that investigate Prashantham and Birkinshaw, 2008 which incentives exist for SMEs to participate in such activities, the nature of participation was not described.

By surveying and interviewing participants of 5G-SOLUTIONS *About - 5G Solutions Project* n.d., it is therefore provided a description of how different stakeholders, SMEs and MNCs in particular, though public institutions are also involved, interfaces with the same collaborative innovation project. The goals of the study as such, can be summarized by the following research questions:

- What does different stakeholders perceive to be the positive and negative impacts of participating in collaborative research- and innovation activities, and what are the perceived causes of the different impacts?
- How does different stakeholders comparatively engage with collaborative research- and innovation activities?

## 2 Methodology

### 2.1 Literature review

The deliverable (Opsahl, 2021) of the author in the NTNU course TIØ4562 was primarily comprised of a systematic literature review that was instrumental in determining appropriate research questions this document attempts to answer, and is provided in its entirety as appendix D. A further, subjectively decided to be relevant, selection of literature was then identified as relevant and reviewed so as to complement the previous work.

### 2.2 Survey

With a birds-eye view of existing research, and decided research questions in mind, a mixed survey was designed for the purposes of measuring engagement and impact of research and innovation projects for different stakeholders over time.

The survey was partitioned into three general sections:

- Classification of interviewee
- Engagement per activity-type over time
- General perception about innovation collaboration

The first section, intended to increase the utility of other answers, was fairly short and sought to classify the respondents based on company size, industry, competency profile, and finally filter out irrelevant respondents. The second section was based on the six unique objectives of 5G-Solutions (*Objectives - 5G Solutions Project* n.d.), asking the respondents to classify activities based on their contribution to each objective, then ascertaining respondent engagement and utility for the respective classes of activities. The third section asked more generally about innovation collaborations, and sought to elicit opinions pertaining to the utility balance, quality of implementation, qualitative and quantitative impacts, and correctness of organization, according to their experiences.

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The complete survey, including both questions and responses, can be found in appendix C, excluding free-form answers for privacy reasons. The survey was designed to measure engagement with different types of research and innovation activities over time.

The survey was distributed through existing networks to participant businesses of 5G-SOLUTIONS and additionally to SME otherwise known to be engaged in collaborative research and innovation activities.

## 2.3 Semi-structured interviews

The interview-guide (appendix A) was designed with preliminary results from the survey in mind (appendix C), and in particular the free-form answers.

The primary purpose of the semi-structured interviews was to ascertain the perceived impact of research and innovation activities upon the interviewees employer organizations. Emphasis on perceived. For this reason, interviewees were generally encouraged to be elaborate on the topics they thought the activities achieved or missed out on significant impacts. The interview guide used is included in appendix A, which includes the full repertoire of questions and topics to bring up, though not all interviews were asked the same set of questions, or made to spend equal amounts of time on each topic. Each interview was also conducted with relatively tight time constraints, i.e. 30 minutes, further necessitating the per-interview triage of topics.

The first interview was with a SME that is currently engaged in the large research and innovation project 5G-SOLUTIONS (*About - 5G Solutions Project* n.d.), and were specifically invited to provide a SME perspective. The second interview was with a large multi-national corporation with several tens of thousands of employees and with operations in several different continents. This corporation was specifically invited to provide an MNC perspective, though they are engaged with 5G-SOLUTIONS in both participatory and administrative capacities. The third interview was with another SME, that also has extensive experience pertaining to the organization of collaborative research and innovation endeavours. This organization is also engaged in 5G-SOLUTIONS, and was extended an invitation so as to supplement the previous interview of an SME, hopefully in combination with insights into the administrative side of collaborative innovation activities.

## 2.4 Analysis

This article comprising a descriptive study, the collected data was not so much analyzed as structured and visualized. Organizing the data using different techniques makes different kinds of insights readily apparent. The performed analysis was not exhaustive however, and in particular analysis of different subsets of the collected data was deemed outside of scope.

## 3 Theory

As previously mentioned, the scope of this article is in large part determined by preceding work (Opsahl, 2021), which is provided in appendix D, in which chapter 5 (Theory) and chapter 7.1 (presentation of articles) contain descriptions of existing research that form parts of the relevant theoretical backdrop for the article you are reading. The remainder of this section however contains descriptions of further research that has been found to be relevant.

In *Dancing with Gorillas* (Prashantham and Birkinshaw, 2008) it is found that "there are real opportunities for smaller firms to engage meaningfully with MNCs, especially if they do so proactively and with a view to the long-term evolution of the relationship." - in particular for SMEs contributing to the relationship by means of knowledge-intense work. For SMEs with offerings that consist of, or relates to, bleeding edge technology, it is suggested that only business strategies involving collaboration with MNCs might be viable.

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On the flip side, in *Partnering with Startups Globally: Distinct Strategies for Different Locations* (Prashantham, 2021b), the authors maintain that it is similarly necessary for MNCs to engage with startups to accelerate the rate at which they are able to innovate. They go on to discuss strategies for leveraging the international nature of MNCs to successfully achieve this.

In *New ventures as value cocreators in digital ecosystems* (Prashantham, 2021a), the authors set out to describe strategies for startups to thrive in innovation ecosystems on the basis that little heed has been paid in previous research to the startup, i.e. SME, point-of-view. They find that "key relational capabilities they need include the capacity to align with the hub firm's priorities for mutual benefit, (...) and to recognize and leverage venues (e.g. events) for relationship-building."

In *Engaging with Startups to Enhance Corporate Innovation* (Weiblen and H. W. Chesbrough, 2015), the authors present a framework of different modalities of SME engagement for MNCs to extract value from innovation ecosystems by leveraging the "speed, innovativeness, and growth potential of entrepreneurial activity". The incentives for SMEs to participate in such arrangements revolve around the facilitation of their growth. Incentives for MNC participation include financial performance, rapid innovation, and strategic risk management, though it is clear that a long-term commitment from the MNC is typically required in order to see significant returns from their involvement.

In *The Future of Open Innovation: The future of open innovation is more extensive, more collaborative, and more engaged with a wider variety of participants* (H. Chesbrough, 2017), the author concludes that collaborative research and innovation efforts will generally become more important, and increasingly be relevant to larger parts of the stakeholders' business models, i.e. transitioning from purely technology-focused open innovation efforts.

In *Exploring open innovation in the digital age: A maturity model and future research directions* (Enkel et al., 2020), the authors suggest several avenues for further research, i.e. questions that have yet to be answered by research, pertaining to open innovation, including "How to analyze open innovation collaboration in terms of their boundaries, leverage, scope, structure, and dynamics?".

## 4 Article

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# Impact of participation in- and engagement with collaborative research- and innovation activities

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## Abstract

This study investigates the impact of participation in- collaborative research- and innovation activities for SMEs and MNCs, and how they respectively engage with such activities. A survey is performed on a non-random sample of 42 participants in research and innovation projects, and further supplemented with three depth-interviews of a subset of survey participants. Key findings: SMEs benefit from technology-related activities, while MNCs benefit from business-related activities as well. Heavy-handed bureaucracy in projects is a major point of friction for SMEs. Both SMEs and MNCs view the establishment of relationships with the other partners as valuable in terms of unrelated business opportunities. The collected data has not been exhaustively analyzed, and so could also provide opportunities for further research.

**Keywords:** Open Innovation, SME, MNC, Research & Innovation.

## 1 Introduction

Based on a previous systematic review [5] of relevant literature, a research gap was identified on the topic of the SME perspective in collaborative research and innovation projects. The literature review was initially concerned with the usage of *Lean Startup*-methodologies in the context of open innovation [8], but also looked at its role in *triple helix*-ecosystem [2]. During the process, a research gap pertaining to the interaction between SMEs and collaborative innovation activities was identified. Though some research ex-



ists that investigate [7] which incentives exist for SMEs to participate in such activities, the nature of participation was not described.

By surveying and interviewing participants of 5G-SOLUTIONS [1], it is therefore provided a description of how different stakeholders, SMEs and MNCs in particular, though public institutions are also involved, interfaces with the same collaborative innovation project. The goals of the study as such, can be summarized by the following research questions:

- What does different stakeholders perceive to be the positive and negative impacts of participating in collaborative research- and innovation activities, and what are the perceived causes of the different impacts?
- How does different stakeholders comparatively engage with collaborative research- and innovation activities?

## 2 Theory

One study that exists on the benefits for SMEs to participate in collaborative research and innovation activities is *Dancing with Gorillas* [7], where it is found that there might be a strategic benefit for SMEs to leverage e.g. *Open Innovation* [4] ecosystems to develop their relationships with select MNCs.

The MNC perspective is significantly better researched. *New ventures as value cocreators in digital ecosystems* [6] explore how MNCs can leverage their global presence to interact with SMEs outside of innovation hubs to both of their benefits. *Engaging with Startups to Enhance Corporate Innovation* [9] explores different modalities for interfacing with SMEs, to make collaboration more mutually beneficial.

In *The Future of Open Innovation: The future of open innovation is more extensive, more collaborative, and more engaged with a wider variety of participants* [3], the author predicts that in the future, collaborative research and innovation efforts will become more frequent and to a greater degree comprise of business innovation efforts.

Broadly, Open innovation from the MNC perspective is relatively well understood, while studies concerning themselves with SMEs describe the outcomes of activities, and not how the SMEs engage with them.

## 3 Methodology

The research done in connection with this article was designed as a *cross-sectional descriptive* study, as that was considered the best fit for the

objectives of the study, and also because it was judged to be the best way to complement the existing body of research.

**Data collection** was done in three ways. First off, a previously performed systematic literature review [5] formed the basis for the research questions of the article. Further, a limited literature review was conducted for this article, in particular to contextualize the research questions with respect to existing research in a stand-alone manner.

Then a survey was conducted, the sample for which was selected by extending direct invitations through established networks. Invitations were extended to participants of 5G-Solutions, and to other businesses known to have participated in research and innovation projects.

Finally, semi-structured in-depth interviews were conducted with four respondent from the survey, distributed over three separate interviews. The respondents were selected so as to represent both SMEs and MNCs, with various roles and perspectives in context of research and innovation projects.

**Data analysis** was in accordance with the decision to perform a descriptive study not designed to make inferences or extrapolate from the data. However, different techniques in grouping, sorting, and aggregating data were still utilized to uncover insights relevant to the research questions.

Thanks to much care being paid to privacy and anonymity during data collection, it is possible to use the data as a basis for further research, for example by combining it with other data or simply by a more detailed breakdown.

## **4 Results**

The survey yielded a total of 42 responses, of which 24 and 18 was from employees of SMEs and MNCs respectively. Respondents indicate that technology competence is very relevant for their role, and most of the respondents also indicate that business competence is relevant to their role. 39 respondents state to have been involved in research and innovation projects, and 31 state to have been involved in 5G-SOLUTIONS specifically.

A total of three semi-structured interview were also conducted to supplement the survey, with a diverse sample of roles in research and innovation projects. The first interview was with a SME that is currently engaged in the large research and innovation project 5G-SOLUTIONS [1], and were specifically invited to provide a SME perspective. The second interview was with a large multi-national corporation with several tens of thousands of employees and with operations in several different continents. This corporation was specifically invited to provide an MNC perspective, though they

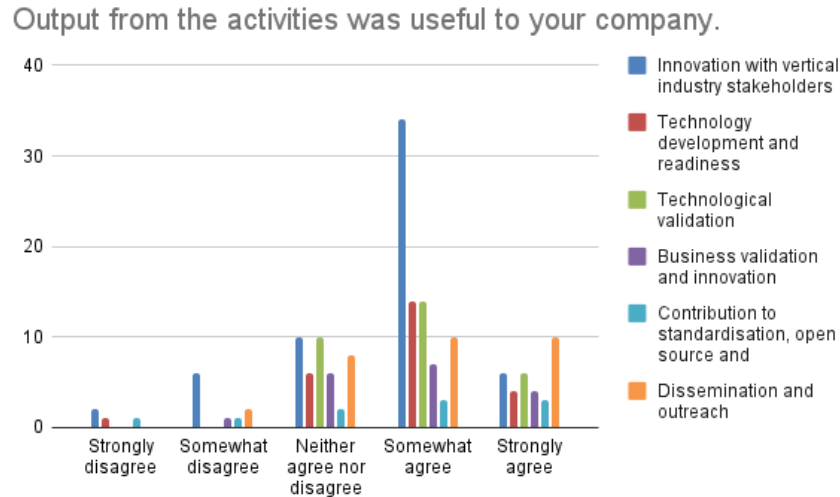


Figure 1 Output from the activities was useful to your company.

are engaged with 5G-SOLUTIONS in both participatory and administrative capacities. The third interview was with another SME, that also has extensive experience pertaining to the organization of collaborative research and innovation endeavours. This organization is also engaged in 5G-SOLUTIONS, and was extended an invitation so as to supplement the previous interview of an SME, hopefully in combination with insights into the administrative side of collaborative innovation activities.

#### 4.1 What does different stakeholders perceive to be the positive and negative impacts of participating in collaborative research- and innovation activities, and what are the perceived causes of the different impacts?

In figure 1 you can see how the output from each type of activity was deemed valuable in itself according to the respondents. There is some differences in the distribution for each category, e.g. respondents engaged with dissemination and outreach-activities appears to agree more strongly that the output of their activities is valuable to their firm, but due to the limited sample size it is not reasonable to conclude anything else than that the participants generally agrees that output from activities is useful for their firms outside in

other contexts. There is an almost exactly similar patterns in figure 2, where respondents seem to agree on the idea that their contribution to each of the activities is valuable to other project participants.

In addition to that, the SME-respondents in the in-depth interviews consistently reported optimism regarding future business opportunities with MNCs in the project, e.g. the following statements:

Since we are a big company, I think all of the project activities are valuable for us, because we have relationships with actors in every sector of the industry.

The relationship with other partners, including a certain MNC in particular, has been positively impacted on the business side. Working back to back constantly during almost three years has made it is easier to be transparent with- and approach the other partners. That might not directly translate into benefits on the business side, but if I see it from my perspective I got to the level of familiarity with certain partners that I think these business relationships could potentially keep moving.

A particular MNC for instance has a lot of relevant needs in their production environment, and having access to decision makers there is an advantage for us in order to establish new business.

In figure 3 and figure 4 respectively, we see by what means the respondents thought the research and innovation project would benefit their firm before entering, and by what means it ended up benefiting them in actuality. Significantly we see that after participating in the project, the respondents seems to become less positive of each type of benefit, though more firmly on the positive side of nearly every type of benefit materializing to at least some extent.

From the MNC perspective, there is also optimism regarding future business opportunities arising from the project, but moreso tied to the technology itself, and other project partners of a significant size:

First of all we could expand our current market offering by means of the output from the research and innovation project, though simultaneously we could probably also use it as the basis for new offerings entirely, and we could potentially work with the project partners to further expand this project into other areas.

Output from the activities was useful to other companies in the inter-organizational research- and innovation project.

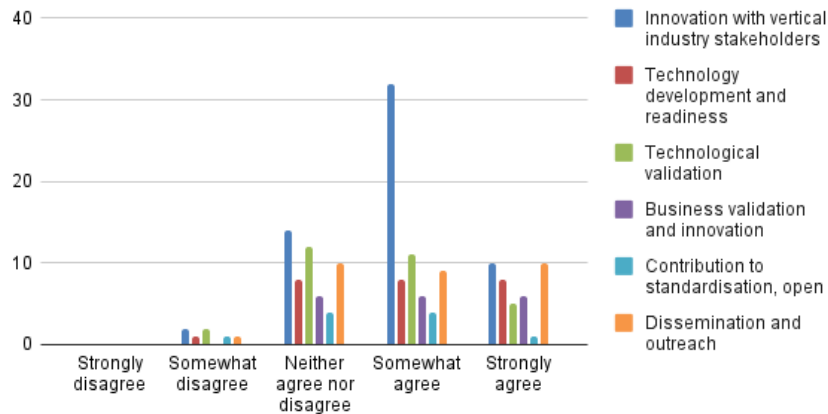


Figure 2 Output from the activities was useful to other companies in the inter-organizational research- and innovation project.

I think that from a research and development point of view there is grounds for collaboration beyond the scope and timeline of the project. Papers and standardization are obvious. Business is somewhat delicate, as we expect to be at a tier of technology readiness level at projects end that is close to viable for commercialization, so that we can hit the market in a matter of months.

I want to stress the importance of working with verticals, who are also potential clients. Gaining a better understanding of their requirements not only lets us advertise our technology better, but also helps us contribute to downstream business models where we act as suppliers.

As for organizational improvements of collaborative research and innovation activities 5, it is worth noting that most of the respondents are answering on activities they participated in throughout the covid-19 pandemic, as shown in figure 7. With that in mind it is no surprise that improvements to inter-organization interfaces are the most indicated to potentially improve the quality of a research and innovation project. It is also worth noting in figure 1 and figure 2 that more recent activities seem to be more positively viewed,

What was the intentions of participating in an inter-organizational research- and innovation project?

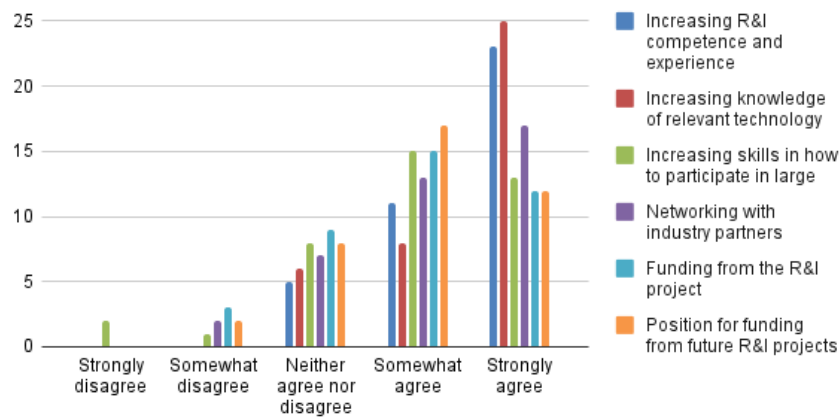


Figure 3 What was the intentions of participating in an inter-organizational research- and innovation project?

Based on activities performed so far in an inter-organizational research- and innovation project, what have been the positive

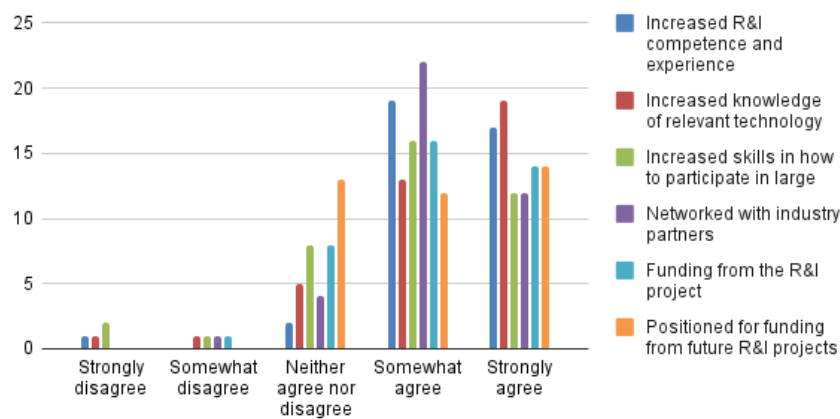


Figure 4 Based on activities performed so far in an inter-organizational research- and innovation project, what have been the positive outcomes for your company?

What kind of activities could receive more focus in R&I projects to improve overall project quality?

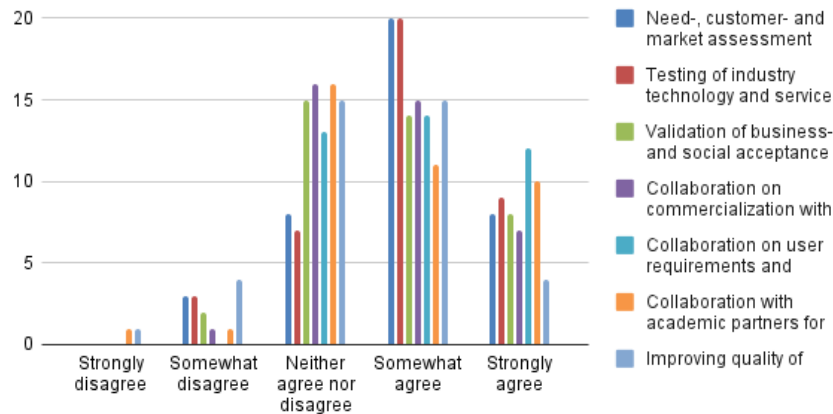


Figure 5 What kind of activities could receive more focus in R&I projects to improve overall project quality?

perhaps due to either recency-bias or simply the end of covid-19 restrictions. Pertaining to covid-19 the interviewees were unanimous in their concerns, confirming the idea that it adversely affected coordination:

Covid-19 certainly was a factor, and I feel there was a lot more of creativity and collaboration in the first year of the project, meeting face to face. Those meetings were great to build relationships and network, and then covid-19 limited the spirit of the project to a degree.

It was a pity we had the covid-19 issue that caused people to only meet electronically, which is again a limitation for both dissemination and mutual understanding. The big advantage of this kind of project is to put people of different professional backgrounds together.

Furthermore, the SME interviewees were concerned with the project scope, length, complexity and administrative burden of the project, e.g.:

I would like a smaller project, less members and less goals as well. Smaller project in general.

The general sentiment being that the utility of the innovation project dropped off for SMEs after the initial phases, due to them to a large part being centered around technology and having a supplier-like role. Additionally, some pointed out the lack of security- and legal resources as a barrier to commercialization, where liability might pose a significant risk to the viability of potential offering in some scenarios:

It is a general problem for collaborative research and innovation activities that certain risks are not managed in the development phases. Security-wise, future critical infrastructure is potentially left vulnerable to e.g. state-sponsored threat actors. We have seen what is happening now in Ukraine, and I think every project really needs to take the security aspect into account. Another aspect is that we maybe should have access to experts in law, as there are complicated questions concerning liability, tightly coupled to complex supply chains, that are very relevant to the commercialization phases of projects. If a power plant drops due to some issue when you have city with no energy so it is fairly critical.

#### **4.2 How does different stakeholders comparatively engage with collaborative research- and innovation activities?**

The data in figure 6 is interesting in that it shows a distinct U-shape for the time-commitment across most activity classes. This can be indicative of the participatory businesses having certain key personnel engaged with the research and innovation project over a longer time-frame, with some of the participants mostly being engaged in regular operations. In figure 7 we see that more resources committed by the respondents typically have happened more recently. Seeing as the pattern is consistent across all classes of activities, this is likely an indicator of participant businesses rotating the people they commit to the project, where people who were engaged with the project in for example 2019 would be less likely to answer a survey about the project in 2022. One SME confirmed the turnover of personnel in the following statement:

It was just too many people, too many companies, and that it just went on for too long, so it was really hard to keep momentum. Multiple partners have even changed key personnel interfacing with the project.



(...) estimate the total number of hours you've comitted to the activities.

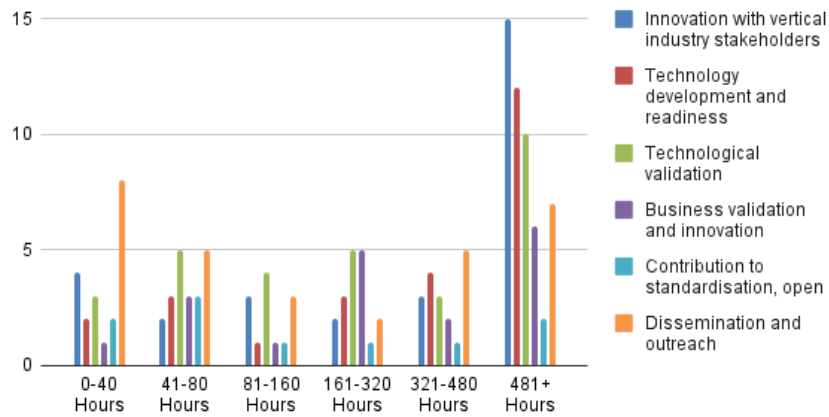


Figure 6 To the best of your ability, estimate the total number of hours you've committed to the activities.

During which periods of time did you participate in the activities?

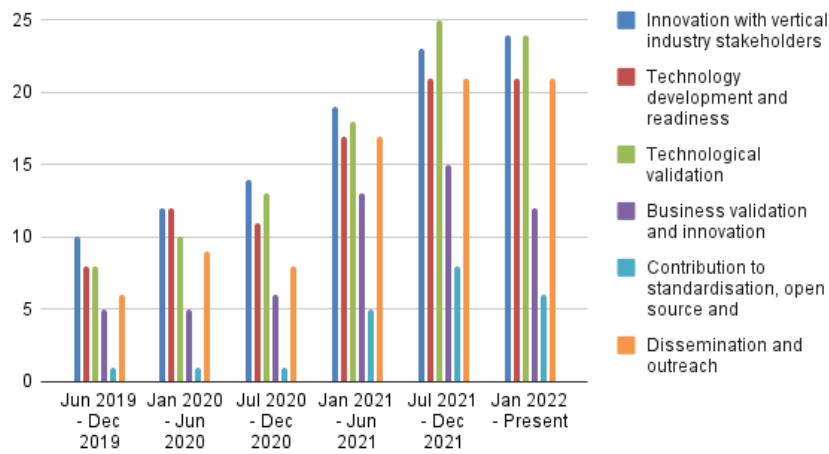


Figure 7 During which periods of time did you participate in the activities?

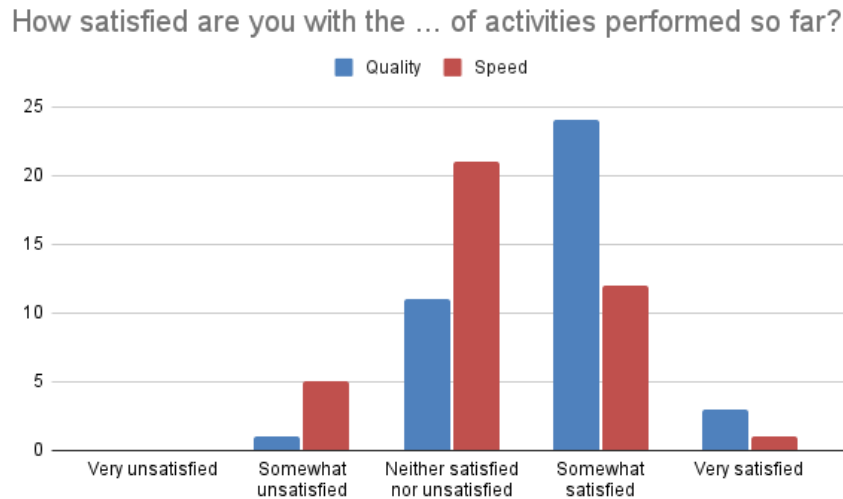


Figure 8 How satisfied are you with the ... of activities performed so far?

Figure 8 is interesting in that it shows the general perception that meticulousness have been prioritized at the cost of speed. This is consistent with the following statement by an MNC interviewee, who according to previous quotes is the organization most suited to thrive in a complex project environment:

The complexity involved makes it hard hard to plan the process across all steps, as the final output will often diverge significantly from what was initially planned.

Figure 9 and figure 10 seems to generally confirm that the relevant activities have not been unnecessarily burdened and hindered by artificial constraints, in spite of some interviewees indicating a high amount of reporting:

(...). The second thing is the amount of deliverables and the amount of meetings. I have never seen a project a project with that much amount of reporting effort. I think this negatively affects effectiveness and efficiency of implementation. And it needs to be simplified for the next project, because otherwise we just stay all the time reporting, reporting, reporting, without actually doing.

The activities were (...) not primarily driven by external factors such as deadlines.

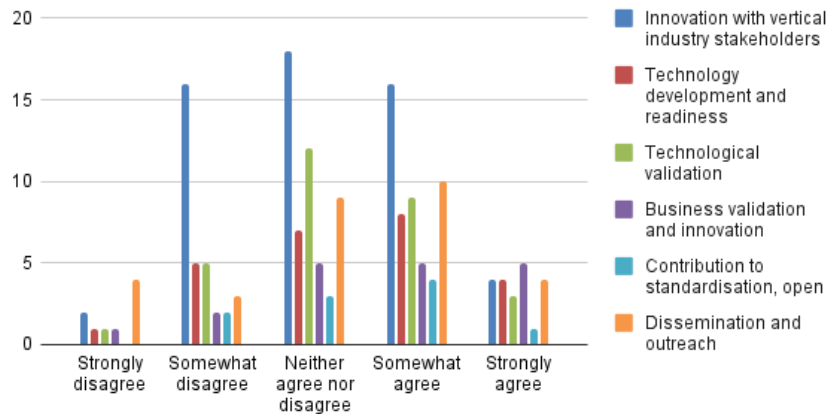


Figure 9 The activities were executed in accordance with your company’s preferences, and not primarily driven by external factors such as deadlines.

So it is clear that significant resources have been committed to enforcing certain standards at certain points in the project, and while some think it has been excessive, it has at least not been a significant detriment to the work done.

As might be expected, figure 11 indicates that covid-19, and on a probably related note coordination with project partners, has been major obstacles for the research and innovation projects the last three years. Interestingly, however, is also the high prevalence of answers pertaining to lack of insight into user requirements and lack of validation of technological KPIs. These are consistent with one of the interviewees gripes about a lack of agility and continuity between distinct phases of the project. Here are some of the statements from different interviews, affirming the aforementioned idea:

In the initial phase of the project we would participate in design of the equipment, and we actively collaborated with a lot of partners, but after the production-environment prototype we lost contact with both development and usage-sides of the technology.

When you want to achieve many goals you can’t plan the entire project in the first phase. Sometimes you don’t expect certain in-

Sufficient resources, internal to your company, were made available to perform the activities.

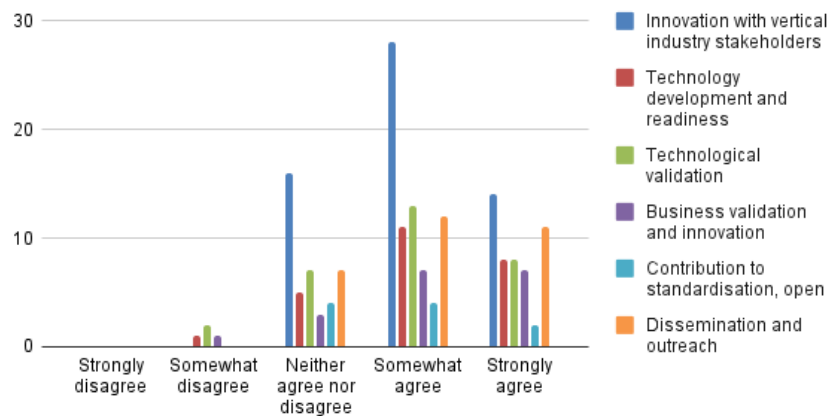


Figure 10 Sufficient resources, internal to your company, were made available to perform the activities.

What were the major reasons for delays in the project activities engaged in?

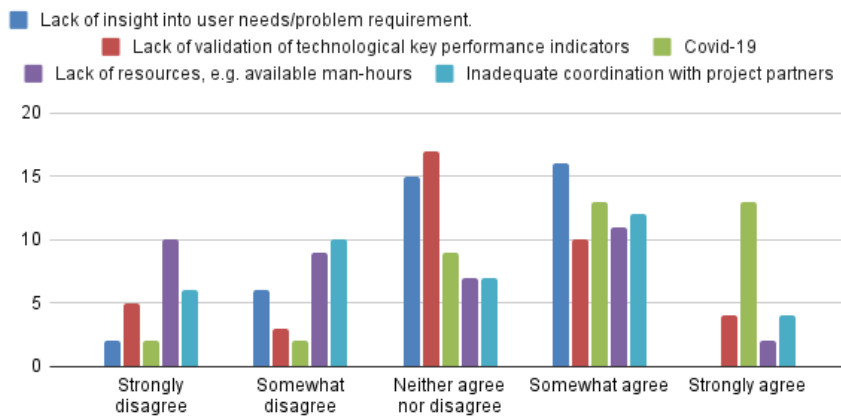


Figure 11 What were the major reasons for delays in the project activities engaged in?

intermediate results. Like in this project we did not expect to have low performance on the provided equipment. Luckily we managed to mitigate the issues and continue the project. But in some other case with some goals depending on others, you can potentially lose parts of the project.

I think the project has too many internal dependencies. We have had several phases where participating in a phase strictly requires high quality output from the previous phase, all of which was planned at the start of the project. There is also a discrepancy where the planning has been very abstract and theoretical, while not allowing for accommodation of issues that might arise during implementation, thus ensuring that adhering to contractual obligations has been less smooth than we expected.

It seems as though all commercial parties involved to some extent sees the project as a waterfall-style project, while they would have preferred a more agile approach.

## **5 Conclusion**

The key findings, per research question, are as follows:

- What does different stakeholders perceive to be the positive and negative impacts of participating in collaborative research- and innovation activities, and what are the perceived causes of the different impacts?
  - Activity output valuable in itself for both SMEs and MNCs.
  - SMEs view the establishment of relationships with MNCs as valuable in terms of potentially unrelated business opportunities.
  - MNCs also viewed obtaining a detailed understanding of potential customer requirements as valuable in terms of potentially future business.
  - Both SMEs and MNCs remain positive, though somewhat less, towards the benefits of participating in collaborative innovation activities after having actually participated in them.
  - The utility of the innovation projects dropped off for the SMEs after phases centered around technology.
- How does different stakeholders comparatively engage with collaborative research- and innovation activities?

- Interaction with project dependent on key personnel for both SMEs and MNCs.
- Some issues caused by the aforementioned key personnel not being assigned to the project for its entirety.
- Activities in different project phases happens in isolation from each other to a disadvantageously large degree.
- SMEs not used to corporate bureaucracy perceived reporting efforts as excessive.
- Projects found to be too front-heavy in planning by both SMEs and MNCs, causing issues with internal deliverable dependencies and cascades of disruptions when the plan fails.

This is a cross-sectional case study based on a small non-random sample in a specific industry, so there are obvious limitations with regards to generalization, i.e. the findings do not generalize without further research. They do however successfully address a research gap in the body of existing literature, where research pertaining to the participation of SMEs in collaborative research and innovation activities have concerned itself with outcomes and not how the different kinds of activities are engaged.

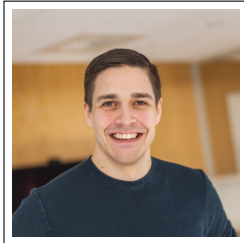
The collected data may also be used as the basis for further research in a more detailed breakdown or in combination with other data.

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## Biography



**Kristoffer Opsahl** is a 2022 graduate of the *Industrial Economics and Technology Management* MSc programme at the *Norwegian University of Science and Technology*, and a software engineer and business developer for *Kantega Single Sign-On*.

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## 5 Conclusion

In addition to the key findings, as presented in the article in chapter 4, and repeated below, a substantial amount of data has been collected, structured and anonymized. See survey responses in appendices C and C.1, interview transcripts in appendix B. This data can potentially be useful in in several kinds of further activities:

- Further, and more detailed, analysis of the existing dataset.
- Analysis of the dataset in combination with other existing datasets.
- Activities taking a closer look at any of the key findings.

Key findings from the article:

- What does different stakeholders perceive to be the positive and negative impacts of participating in collaborative research- and innovation activities, and what are the perceived causes of the different impacts?
  - Activity output valuable in itself for both SMEs and MNCs.
  - SMEs view the establishment of relationships with MNCs as valuable in terms of potentially unrelated business opportunities.
  - MNCs also viewed obtaining a detailed understanding of potential customer requirements as valuable in terms of potentially future business.
  - Both SMEs and MNCs remain positive, though somewhat less, towards the benefits of participating in collaborative innovation activities after having actually participated in them.
  - The utility of the innovation projects dropped off for the SMEs after phases centered around technology.
- How does different stakeholders comparatively engage with collaborative research- and innovation activities?
  - Interaction with project dependent on key personnel for both SMEs and MNCs.
  - Some issues caused by the aforementioned key personnel not being assigned to the project for its entirety.
  - Activities in different project phases happens in isolation from each other to a disadvantageously large degree.
  - SMEs not used to corporate bureaucracy perceived reporting efforts as excessive.
  - Projects found to be too front-heavy in planning by both SMEs and MNCs, causing issues with internal deliverable dependencies and cascades of disruptions when the plan fails.



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## A Interview Guide

### A.1 Intro

- Introduction and thanks.
- Purpose: Understand their role in- and perception of a recent R&I project
- Reminders: Anonymous. 30 minutes.

- 
- Structure: Planning, execution, and retrospective.
  - Emphasize interest in personal opinions.

## A.2 Project Basics

- How many people does your company employ, and what is your role there?
- Which RI project? Plural? Anonymity maintained?
- What kind of project activities have you contributed to? (Have examples ready for probing)
- Be particular about tasks performed, team and output, but ask for a free form explanation.
- Synchronous vs. async?

## A.3 Per-phase participation

- Did you participate in the ng stage of the project, determining requirements and needs?
- Beneficial: Was it / Would it have been / beneficial to your company / if you did / to do so?
- Role: What was your role in this/these activities?
- Colab: Did you (plan to) collaborate with other partners for this activity? How?
- Did you contribute to product testing? Beneficial? Role? Colab with others?
- Did you contribute to product commercialization? Beneficial? Role? Colab with others?
- What part of the business model, if any, do you envision for your company in the long and medium term?
- Did you use tools or frameworks for developing the business model, and were any of them particularly useful?
- Did you contribute to determining if project objectives were achieved? Beneficial? Role? Colab with others?

## A.4 Topics from survey-responses

- No-fault disruptions. (Tie into agile methodology?)
- Agile/lean/other methodology? (How would you describe the methodology used?)
- Non-responsiveness (communication/prioritization with and by partners)
- Org-level interdependencies? (Again, methodology? End-to-end, ordered procedures, what's up?)
- Business-level incentives for actively contributing - in place? [Maybe they're there, but not very well perceived?]. Regardless of answer: How has this affected quality of input, process, output, etc.?
- Goal definition (again, methodology): KPI adherence. What kind of KPIs, and how are they chosen? Outcome-focus?

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## A.5 Retrospective

- Has the project been generally beneficial to your company? In what ways? Why (not)?
- Finance
- Strategy
- Suggestions for improvement for your next RI project, to achieve better results?
- Is your company planning to participate in RI projects in the future?
- What stakeholders (inside and outside ecosystem), if any, would you say had a high impact on the results of your participation?

## A.6 Outro

- Anything talked about that should be emphasized?
- Anything to add?
- Thanks.

Anything talked about that should be emphasized? Anything to add? Thanks.

# B Interview Transcripts

Efforts have been made to protect interviewees' privacy and anonymity:

- Pruning of information that can potentially aid in deanonymization of interviewees
- Syntactic, though not semantic, alteration of the transcripts, through e.g. reformulation of replies

This reconciles the promises of privacy afforded each interviewee with the distribution of their replies.

## B.1 Interview 1

I think it's really important to be involved in the planning phase, because you can determine what the desired outcomes are. Otherwise you are just having a project presented to you, and you have no say in what the end goal is.

We were already involved with [an important partner] before this project, so the first interaction was with them, where we designed an application very early on, exploiting the 5G technology. After that we started to communicate with other partners to build infrastructure, such as an academic partner who delivered technology for the project, and another partner that delivered a downstream system. So all the partners that for a reason or another provide part of the hardware or software inside the infrastructure.

The customer has a large size operation, so it was really important in letting us effectively trial our experiment at a realistic scale. So, cooperating with the corporation was valuable to us.

We planned to deploy our system in two phases. For the first proof of concept we built a demo at our own premises with the aim to replicate the future behaviour of an industrial site. For later cycles we moved the entire architecture to an actual industrial site. Before deployment we tested everything in-house.

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We have the opportunity to be probably the first company to work on a particular technology delivered by an academic partner. And we got a great contribution there, because we soon discovered a performance issue in the provided equipment, so the academic partner analyzed the data we provided them, and delivered an improved version. Now we have a highly performing solution in a production environment, though we could not have progressed the project with the initially provided piece of technology.

We found out about access to high-tech equipment during, not before, the project.

In many aspects pertaining to the provided technology, we collaborated with an academic partner to improve performance. We also ran integration tests in collaboration with another project partner.

We are not concerned with commercialization yet. We used the prototype we built to close a sale, but we still have it as a prototype. Later we will probably work some more on it to make it a part of our standard offering, but at the moment it is not a product ready for production at scale.

First of all we could expand our current market offering by means of the output from the research and innovation project, though simultaneously we could probably also use it as the basis for new offerings entirely, and we could potentially work with the project partners to further expand this project into other areas.

I don't think we are strictly reliant on the project partners for relevant future endeavours, because the technology is becoming a lot more ubiquitous, so I don't think we would need technology access from the academic partner for example, but we could certainly benefit from their knowledge. So there is always future synergy with the business partners, but we would not necessarily rely on them.

No, we have not really done any work on business models pertaining to 5G-SOLUTIONS.

Yes, we are absolutely involved in the process of evaluating if different parts of the project have met their criteria or not.

In the initial phase of the project we would participate in design of the equipment, and we actively collaborated with a lot of partners, but after the production-environment prototype we lost contact with both development and usage-sides of the technology. We would probably benefit if the project lasted half of the time. Also, due to the nature of the technology, there are diminishing returns to benefits in terms of learning. Moreover, our solution was not really compatible with the work to be done in later stages of the project, causing delays and extra work. But the main critique is that the project is too long.

Covid-19 certainly was a factor, and I feel there was a lot more of creativity and collaboration in the first year of the project, meeting face to face. Those meetings were great to build relationships and network, and then covid-19 limited the spirit of the project to a degree. Comparing with previous projects I think losing the opportunity to meet together in the same place for 1-2 days for certain meetings is a pity.

I would like a smaller project, less members and less goals as well. Smaller project in general.

When you want to achieve many goals you can't plan the entire project in the first phase. Sometimes you don't expect certain intermediate results. Like in this project we did not expect to have low performance on the provided equipment. Luckily we managed to mitigate the issues and continue the project. But in some other case with some goals depending on others, you can potentially lose parts of the project.

It was just too many people, too many companies, and that it just went on for too long, so it was really hard to keep momentum. Multiple partners have even changed key personnel interfacing with the project.

Without a particular partner, with whom we had a pre-existing relationship, we would probably not be participating in the project. They also had a large impact on our experience with the project. Specific people from several other partners also did a great job.

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It might have been advantageous to wait more time, until the technology was more mature, so the project did not rely on some custom and non-standard pieces of equipment that are still not suitable for the market. Though it depends, because this was not a pure research project, but had commercial and industrial dimensions as well, making mature infrastructure a big concern.

I, as an engineer, would prefer more focus on technological feasibility, and to remove remove commercial market study.

If you're aiming to make something ready for the industry you need to rely on more mature technology. And for the industrial market you can not spend three years following the same product. You can spend 6 months for research and 12 months for implementation, but then you need to have a final product ready for the market.

## B.2 Interview 2

The project is fairly large, though I was able to participate in most project activities.

I think that from a research and development point of view there is grounds for collaboration beyond the scope and timeline of the project. Papers and standardization are obvious. Business is somewhat delicate, as we expect to be at a tier of technology readiness level at projects end that is close to viable for commercialization, so that we can hit the market in a matter of months.

That something has been endorsed by the standardization bodies is essential to be widely used and adopted in the industry. So, there is also that these technologies has to be considered in standardization bodies and be discussed with other stakeholders to arrive at a common solution.

The steps forward, such as social acceptance of services originating the projects, and the means for commercialization, must also be considered.

One of the major advantages of standardization is economics of scale. If you develop a solution only for a singular customer, the opportunity size would be significantly smaller due to the reduced pool of potential customers. And with a standardized solution you can better scale the investment in research and development based on the expected pool of customers.

Since we are a big company, I think all of the project activities are valuable for us, because we have relationships with actors in every sector of the industry. Additionally, there are two kinds of output that is directly valuable to us: First is a comprehensive understanding of needs in certain industry verticals as they pertain to our market offerings, second is the ability to integrate service concepts from the project into our market offering.

Considering the project activities related to standardization there are two primary advantages. First is the ability to involve industrial entities, who typically consumers more so than contributors to a standard, in the standardization work. There is often a challenge translating between abstract requirements and requirements for physical implementations, and standardization activities helps us understand how our technology can be made to better solve the needs of our future customers. Second is the project provides a great platform for including people from different businesses in standardization work, though many of the relevant people will often not be directly involved with the activities. By involving people from both technical and non-technical sides of the business, you have a great opportunity for people who operate in different professional domains to come together and understand each other.

It was a pity we had the Covid-19 issue that caused people to only meet electronically, which is again a limitation for both dissemination and mutual understanding. The big advantage of this kind of project is to put people of different professional backgrounds together.

I want to stress the importance of working with verticals, who are also potential clients. Gaining a better understanding of their requirements not only lets us advertise our technology better, but also helps us contribute to downstream business models where we act as suppliers.

All types of partners are necessary in the project, both on the business and the technology side.

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There are several intermediate steps between an idea and a business model, and each step typically involves entities of different sizes, often including regulatory and academic actors, as well as commercial ones. The complexity involved makes it hard hard to plan the process across all steps, as the final output will often diverge significantly from what was initially planned.

It is a general problem for collaborative research and innovation activities that certain risks are not managed in the development phases. Security-wise, future critical infrastructure is potentially left vulnerable to e.g. state-sponsored threat actors. We have seen what is happening now in Ukraine, and I think every project really needs to take the security aspect into account. Another aspect is that we maybe should have access to experts in law, as there are complicated questions concerning liability, tightly coupled to complex supply chains, that are very relevant to the commercialization phases of projects. If a power plant drops due to some issue when you have city with no energy so it is fairly critical.

### B.3 Interview 3

I think the project has too many internal dependencies. We have had several phases where participating in a phase strictly requires high quality output from the previous phase, all of which was planned at the start of the project. There is also a discrepancy where the planning has been very abstract and theoretical, while not allowing for accommodation of issues that might arise during implementation, thus ensuring that adhering to contractual obligations has been less smooth than we expected. The output from the planning activities has still been useful, but too theoretical, and we would have benefited from more support and interaction from the people more involved in planning during the implementation stage. I have the feeling as well that covid-19 did not help the issue, because remote interactions makes things really slow down. Much of the planning supposed to happen physically together at a location did not occur at all, which has caused both constraints and deviations.

Collaboration with MNCs has been positive in my opinion, and is always welcome. But again, remote collaboration from the theory perspective is not always enough to achieve certain outcomes and results.

There are specific people at specific partners companies that has had a disproportionate impact for us during the project. Not the same people for all phases, but a handful of people really stand out.

We were newcomers to the technology, so everything we have learned and tested is new knowledge that we have acquired in order to potentially exploit in the future. So the project has been at least somewhat useful the company.

For the technology validation phase of the project, a particular MNC has been the most linked to us. That has created an impact because for sure the collaboration with them, despite the project framework, has improved. And the communication and business discussions have improved thanks to the constant collaboration during the project.

The trials so far are not showing superb results, and because we are newcomers we do not yet fully grasp the extent to which how and if what we are doing has value. It is furthermore quite tricky for us to replicate on the business side, and I think we will never be able to convert it in a service offer to clients. But in comparison to competitors with offerings similar to ours, maybe we are ahead because of technology expertise we have gained that they might not have.

The relationship with other partners, including a certain MNC in particular, has been positively impacted on the business side. Working back to back constantly during almost three years has made it is easier to be transparent with- and approach the other partners. That might not directly translate into benefits on the business side, but if I see it from my perspective I got to the level of familiarity with certain partners that I think these business relationships could potentially keep moving.

With the actual level of results so far we can not pretend that the projects will bring us a sustainable

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business model with our partners. There was a roadmap in the project for developing a business plan, but so far we are facing limitations from working with a technology that is not ready for large-scale deployments.

We have been making business model canvas, PESTEL analysis and so on, as part of a project deliverable in cooperation with another partner. The project-supplied tools for business model development - some of them are useful. I don't know if I should mention that this has been thanks to the deliverable or has been thanks to the knowledge of a particular employee of ours who is the one defining them. I think the supplied framework was too detailed for the level of need in the project.

Well, let's say that the first guidelines or the templates that we were requested to fill out were maybe eight pages of questions. There are frameworks if you need to have a business plan or something, and I believe there is a way to simplify that to better fit the needs and expectations of this particular project. But this was the decision of facilitators, and I think the outcome of these eight pages is that maybe just a couple of them would be answered properly.

Starting a new project like this let us open a new area with new networks and new partners, and we would like to keep developing these kinds of projects in the future. And I have a feeling that hopefully after the project some of the other partners will have a positive impression of us. And this is a way that I see that maybe new projects come up and then of course new business that could happen.

This kind of project affords us a playground to test and access new technologies, in order to integrate them into our portfolio of mature products with mature clients. A particular MNC for instance has a lot of relevant needs in their production environment, and having access to decision makers there is an advantage for us in order to establish new business.

The different phases of the project were disconnected and there was a disconnect between early planning and implementation. This created several complex situations and a lack of engagement. It was challenging communicating across the tech/research/business boundaries, and I believe having direct involvement from each domain in each project phase would work a little bit better, because I think some stakeholders at certain points felt a little bit abandoned. And if they don't see a value or an interest, why bother to make trials out of them.

We need to understand that there are fundamental differences between commercial-, academic- and public sector actors. Commercial actors in particular can be very focused on creating a working product and generating benefits. Even though there is this commitment, they need to see something valuable as well during implementation. The second thing is the amount of deliverables and the amount of meetings. I have never seen a project a project with that much amount of reporting effort. I think this negatively affects effectiveness and efficiency of implementation. And it needs to be simplified for the next project, because otherwise we just stay all the time reporting, reporting, reporting, without actually doing.

Can not think of any stakeholders in particular that has had a high impact for us.

I think a challenge here is the heavy emphasis on research, and I think accommodating the business paradigm to a larger degree is a challenge none of the research-oriented stakeholders fully understand how to tackle.

They are putting the ball in our side, to see what we are able to achieve, and essentially just telling us good luck. But well, I think at least we have handled it quite well by pragmatically assuming some risk and getting the business-side of things done by whichever means necessary and available, i.e. not according to plan. Let's say we would have a system that worked at a lab-level, but hopefully now before the end of the project, we will be able as well to test some industry oriented commercial solution as well. With that approach we will cover both research and business, but we don't know how this will be from the eyes of the project organizers. It's a risk that we take in our account, but I believe it is a worthwhile risk because the justification behind and the reasoning behind it's covering the whole aspects of the project itself, having research and commercialization on the two levels. So we are crossing fingers when hopefully that could be a solution to this dilemma.

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## C Survey Responses

### C.1 Answers to open-ended questions

**What were the other reasons for delays?**

- Delays in establishment of the test-bed facilities
- Extent of communication requirement with internal stakeholders, agreeing use cases , performing tests etc.
- Equipment installation errors and the bureaucracies involved in resolving them.
- Some partners are not that responding to emails, calls etc.
- Inter partner dependencies in the building block of both technical and business activities
- The outcomes from the project were not sufficiently important to enough partners. There were not enough partners for whom the success of the project was linked to the long-term success of their business.

**What were the other intentions for participating in an inter-organizational research- and innovation project?**

- Taking part in an arena enabling and supporting dissemination and communication

**What were the other benefits for participating in an inter-organizational research- and innovation project?**

- Established platform / facility for testing, experimentation and technical validation - Taking part in an arena enabling and supporting dissemination and communication

**Based on the activities performed so far in an inter-organizational research- and innovation project, what are your suggestions for improvement of the work done? - Other suggestions**

- More time for test case development, validation methodology development.
- In relation to "More time and resources spent on the initial deliverables in the project (as a means to better facilitate later activities)", I would advocate for a more agile way of working, finding the right balance between reporting on "sufficient work done" and acknowledging the progress and time required for Knowledge Acquisition (KA) this could mean smaller deliverables and more focus but more frequent if needed (version a, b, c, d).
- a) include more partners who are capable of actually impacting their business with outputs from the project b) make it more an imperative that their business NEEDS the outputs from the project.
- Partners need to be on time to their responsibilities.

**If you have any other thoughts or suggestions on how to improve inter-organizational research and innovation projects, please enter them here.**

- I think the research should have a commercialization goal, that research as an end in itself is not the point of cross industry collaboration and that the KPI's should drive the project.

### C.2



| What is the size of your company? | What industry are you related to?                   | What industry are you related to - Other. Please specify. | Business-, market- or industry competence is important for the tasks you perform for your company. | Technological competence is important for the tasks you perform for your company. | Have you to any extent participated in any activity in an inter-organizational research- and innovation project? | The structure of the following sections survey is based on the EU-funded 5G-SOLUTIONS project, part of the EU-funded 5G Infrastructure Public Private Partnership (5G-PPP). Regardless, you should answer on the basis of your experiences from inter-organizational research- and innovation projects where you've been a participant. Have you to any extent participated in any activity contributing to the objectives of 5G-SOLUTIONS? |
|-----------------------------------|---|---|--|---|--|---|
| 250+ employees                    | Information and communication                       |   | 4  | 5   | Yes  | Yes   |
| 250+ employees                    | Information and communication                       |   | 4  | 5   | Yes  | Yes   |
| 41-70 employees                   | Information and communication                       |   | 5  | 5   | Yes  | Yes   |
| 250+ employees                    | Information and communication                       |   | 5  | 5   | Yes  | Yes   |
| 250+ employees                    | Agriculture, forestry and fishing                   |   | 2  | 4   | Yes  | Yes   |
| 250+ employees                    | Manufacturing                                       |   | 3  | 4   | Yes  | Yes   |
| 250+ employees                    | Information and communication                       |   | 4  | 5   | Yes  | No  |
| 250+ employees                    | Information and communication                       |   | 5  | 5   | Yes  | Yes   |
| 21-40 employees                   | Information and communication                       |   | 4  | 4   | Yes  | Yes   |
| 71-130 employees                  | Information and communication                       |   | 4  | 4   | Yes  | Yes   |
| 21-40 employees                   | Information and communication                       |   | 4  | 5   | No   | Yes   |
| 250+ employees                    | Manufacturing                                       |   | 2  | 5   | No   |   |
| 250+ employees                    | Electricity, gas, steam and air conditioning supply |   | 4  | 2   | No   |   |
| 6-10 employees                    | Professional, scientific and technical activities   |   | 3  | 5   | Yes  | No  |
| 21-40 employees                   | Manufacturing                                       |   | 3  | 3   | Yes  | Yes   |
| 250+ employees                    | Information and communication                       |   | 3  | 3   | Yes  | Yes   |
| 41-70 employees                   | Professional, scientific and technical activities   |   | 5  | 5   | Yes  | No  |
| 250+ employees                    | Electricity, gas, steam and air conditioning supply |   | 5  | 3   | Yes  | Yes   |
| 250+ employees                    | Information and communication                       |   | 2  | 5   | Yes  | No  |
| 11-20 employees                   | Other service activities                            |   | 4  | 4   | Yes  | Yes   |
| 21-40 employees                   | Professional, scientific and technical activities   |   | 4  | 5   | Yes  | No  |
| 41-70 employees                   | Professional, scientific and technical activities   |   | 5  | 4   | Yes  | No  |
| 41-70 employees                   | Information and communication                       |   | 5  | 5   | Yes  | No  |
| 41-70 employees                   | Information and communication                       |   | 5  | 5   | Yes  | No  |
| 21-40 employees                   | Information and communication                       |   | 5  | 5   | No   |   |
| 41-70 employees                   | Information and communication                       |   | 3  | 3   | Yes  | Yes   |
| 71-130 employees                  | Professional, scientific and technical activities   |   | 3  | 5   | Yes  | Yes   |
| 21-40 employees                   | Other service activities                            |   | 5  | 4   | Yes  | Yes   |
| 11-20 employees                   | Other   | Computer Systems Design and Related Services              | 3  | 3   | Yes  | Yes   |
| 11-20 employees                   | Other service activities                            |   | 4  | 5   | Yes  | Yes   |
| 71-130 employees                  | Professional, scientific and technical activities   |   | 4  | 5   | Yes  | Yes   |
| 250+ employees                    | Information and communication                       |   | 4  | 5   | Yes  | Yes   |
| 250+ employees                    | Information and communication                       |   | 3  | 5   | Yes  | Yes   |
| 6-10 employees                    | Information and communication                       |   | 5  | 5   | Yes  | Yes   |
| 21-40 employees                   | Information and communication                       |   | 5  | 5   | Yes  | Yes   |
| 250+ employees                    | Information and communication                       |   | 5  | 5   | Yes  | Yes   |
| 250+ employees                    | Information and communication                       |   | 4  | 5   | Yes  | Yes   |
| 250+ employees                    | Information and communication                       |   | 5  | 5   | Yes  | Yes   |
| 11-20 employees                   | Other service activities                            |   | 4  | 4   | Yes  | Yes   |

|                 |   |  |   |   |     |     |
|-----------------|---|--|---|---|-----|-----|
| 21-40 employees | Professional, scientific and technical activities |  | 5 | 2 | Yes | Yes |
| 6-10 employees  | Other service activities                          |  | 5 | 3 | Yes | Yes |
| 250+ employees  | Information and communication                     |  | 5 | 3 | Yes | Yes |

| Have you in any capacity contributed to activities relevant to innovation with vertical industry stakeholders? | The activities were executed in accordance with your company's preferences, and not primarily driven by external factors such as deadlines. | Output from the activities was useful to your company. | Output from the activities was useful to other companies in the inter-organizational research- and innovation project. | Sufficient resources, internal to your company, were made available to perform the activities. | Output from the activities could contribute to form the basis for a sustainable source of revenue for your company. | To the best of your ability, estimate the total number of hours you've committed to the activities. |
|--|---|--|--|--|---|---|
| Yes  | 3   | 5  | 5  | 3  | 4   | 481+ Hours   12+ Weeks  |
| Yes  | 4   | 4  | 4  | 4  | 3   | 41-80 Hours   1-2 Weeks   |
| Yes  | 3   | 2  | 4  | 5  | 3   | 481+ Hours   12+ Weeks  |
| Yes  | 3   | 4  | 4  | 4  | 4   | 481+ Hours   12+ Weeks  |
| No   |   |  |  |  |   |   |
| Yes  | 4   | 3  | 2  | 3  | 2   | 481+ Hours   12+ Weeks  |
| Yes  | 5   | 4  | 3  | 4  | 3   | 161-320 Hours   4-8 Weeks   |
| Yes  | 2   | 4  | 4  | 5  | 5   | 481+ Hours   12+ Weeks  |
| Yes  | 2   | 3  | 4  | 3  | 3   | 81-160 Hours   2-4 Weeks  |
| Yes  | 4   | 4  | 4  | 3  | 4   | 0-40 Hours   0-1 Week   |
| Yes  | 3   | 4  | 4  | 5  | 3   | 481+ Hours   12+ Weeks  |
|  |   |  |  |  |   |   |
| No   |   |  |  |  |   |   |
| Yes  | 3   | 3  | 3  | 3  | 3   | 481+ Hours   12+ Weeks  |
| Yes  | 4   | 4  | 3  | 4  | 3   | 481+ Hours   12+ Weeks  |
| No   |   |  |  |  |   |   |
| Yes  | 2   | 4  | 3  | 4  | 3   | 321-480 Hours   8-12 Weeks  |
| Yes  | 2   | 4  | 4  | 4  | 2   | 0-40 Hours   0-1 Week   |
| No   |   |  |  |  |   |   |
| Yes  | 4   | 4  | 4  | 4  | 4   | 41-80 Hours   1-2 Weeks   |
| No   |   |  |  |  |   |   |
| Yes  |   | 4  | 4  | 3  | 4   | 0-40 Hours   0-1 Week   |
| Yes  | 2   | 4  | 3  | 3  | 4   | 321-480 Hours   8-12 Weeks  |
|  |   |  |  |  |   |   |
| Yes  | 3   | 3  | 3  | 3  | 3   | 0-40 Hours   0-1 Week   |
| No   |   |  |  |  |   |   |
| Yes  | 2   | 2  | 4  | 4  | 2   | 321-480 Hours   8-12 Weeks  |
| No   |   |  |  |  |   |   |
| Yes  | 2   | 1  | 5  | 5  | 3   | 481+ Hours   12+ Weeks  |
| No   |   |  |  |  |   |   |
| Yes  | 3   | 4  | 3  | 5  | 4   | 161-320 Hours   4-8 Weeks   |
| No   |   |  |  |  |   |   |
| Yes  | 4   | 4  | 4  | 4  | 4   | 481+ Hours   12+ Weeks  |
| No   |   |  |  |  |   |   |
| Yes  | 5   | 5  | 5  | 4  | 4   | 481+ Hours   12+ Weeks  |
| Yes  | 4   | 2  | 4  | 4  | 2   | 481+ Hours   12+ Weeks  |
| Yes  | 3   | 4  | 4  | 4  | 3   | 81-160 Hours   2-4 Weeks  |
| Yes  | 1   | 5  | 4  | 4  | 4   | 481+ Hours   12+ Weeks  |

|     |   |   |   |   |                            |
|-----|---|---|---|---|----------------------------|
| Yes | 2 | 4 | 4 | 5 | 2 81-160 Hours   2-4 Weeks |
| Yes | 3 | 3 | 5 | 5 | 3 481+ Hours   12+ Weeks   |
| Yes | 4 | 4 | 5 | 4 | 5 481+ Hours   12+ Weeks   |

| During which periods of time did you participate in the activities?   | Have you in any capacity contributed to activities relevant to innovation with vertical industry stakeholders? | The activities were executed in accordance with your company's preferences, and not primarily driven by external factors such as deadlines. | Output from the activities was useful to your company. | Output from the activities was useful to other companies in the inter-organizational research- and innovation project. | Sufficient resources, internal to your company, were made available to perform the activities. | Output from the activities could contribute to form the basis for a sustainable source of revenue for your company. |
|---|--|---|--|--|--|---|
| Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 3  | 4  | 5  | 4   |
| Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | Yes  |   | 4  | 4  | 4  | 3   |
| Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 3  | 3  | 5  | 3   |
| Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 3  | 4  | 3  | 4   |
| Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 3  | 4  | 2  | 3   |
| Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | No   |   |  |  |  |   |
| Jan 2020 - Jun 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present   | Yes  |   | 5  | 4  | 3  | 4   |
| Jan 2022 - Present  | Yes  |   | 2  | 5  | 5  | 5   |
| Jan 2021 - Jun 2021; Jul 2021 - Dec 2021  | No   |   |  |  |  |   |
| Jul 2021 - Dec 2021; Jan 2022 - Present   | No   |   |  |  |  |   |
| Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 4  | 4  | 5  | 5   |
|   |  |   |  |  |  |   |
|   | Yes  |   | 5  | 4  | 5  | 4   |
| Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present                      | Yes  |   | 5  | 5  | 5  | 5   |
| Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 4  | 4  | 4  | 3   |
| Jul 2021 - Dec 2021; Jan 2022 - Present   | No   |   |  |  |  |   |
| Jan 2022 - Present  | Yes  |   | 2  | 3  | 3  | 4   |
| Jan 2022 - Present  | Yes  |   | 2  | 4  | 4  | 2   |
|   | No   |   |  |  |  |   |
| Jul 2021 - Dec 2021   | Yes  |   | 4  | 4  | 4  | 4   |
|   | No   |   |  |  |  |   |
| Jan 2022 - Present  | No   |   |  |  |  |   |
| Jul 2021 - Dec 2021; Jan 2022 - Present   | Yes  |   | 2  | 3  | 3  | 3   |
| Jan 2021 - Jun 2021; Jul 2021 - Dec 2021  | No   |   |  |  |  |   |
|   | No   |   |  |  |  |   |
| Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | Yes  |   | 1  | 1  | 4  | 2   |
|   | Yes  |   | 3  | 3  | 3  | 3   |
| Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 3  | 3  | 5  | 5   |
|   | No   |   |  |  |  |   |
| Jan 2022 - Present  | Yes  |   | 3  | 4  | 3  | 5   |
|   | No   |   |  |  |  |   |
| Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 4  | 4  | 4  | 4   |
|   | Yes  |   | 4  | 5  | 3  | 5   |
| Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 5  | 5  | 5  | 4   |
| Jul 2020 - Dec 2020   | Yes  |   | 2  | 3  | 4  | 5   |
| Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | Yes  |   | 4  | 4  | 4  | 4   |
| Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present                      | No   |   |  |  |  |   |

|  |     |   |   |   |   |   |   |
|--|-----|---|---|---|---|---|---|
| Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021  | No  |   |   |   |   |   |   |
| Jan 2022 - Present   | No  |   |   |   |   |   |   |
| Jun 2019 - Dec 2019; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes | 4 | 4 | 3 | 3 | 3 | 3 |

| To the best of your ability, estimate the total number of hours you've committed to the activities. | During which periods of time did you participate in the activities?   | Have you in any capacity contributed to activities relevant to innovation with vertical industry stakeholders? | The activities were executed in accordance with your company's preferences, and not primarily driven by external factors such as deadlines. | Output from the activities was useful to your company. | Output from the activities was useful to other companies in the inter-organizational research- and innovation project. | Sufficient resources, internal to your company, were made available to perform the activities. |
|---|---|--|---|--|--|--|
| 481+ Hours   12+ Weeks  | Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present                      | Yes  |   | 4  | 4  | 5  |
| 0-40 Hours   0-1 Week   | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | No   |   |  |  |  |
| 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 3  | 5  | 5  |
| 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 3  | 4  | 3  |
| 161-320 Hours   4-8 Weeks   | Jul 2021 - Dec 2021   | Yes  |   | 3  | 3  | 2  |
|   |   | Yes  |   | 2  | 4  | 3  |
| 161-320 Hours   4-8 Weeks   | Jan 2020 - Jun 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present   | No   |   |  |  |  |
| 481+ Hours   12+ Weeks  | Jan 2022 - Present  | Yes  |   | 3  | 3  | 3  |
|   |   | Yes  |   | 3  | 4  | 4  |
|   |   | Yes  |   | 4  | 4  | 3  |
| 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 4  | 4  | 4  |
|   |   |  |   |  |  |  |
| 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 5  | 3  | 4  |
| 481+ Hours   12+ Weeks  | Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present                      | Yes  |   | 5  | 5  | 5  |
| 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 4  | 5  | 4  |
|   |   | Yes  |   | 2  | 3  | 3  |
| 321-480 Hours   8-12 Weeks  | Jul 2021 - Dec 2021; Jan 2022 - Present   | Yes  |   | 2  | 3  | 4  |
| 0-40 Hours   0-1 Week   | Jan 2022 - Present  | Yes  |   | 2  | 4  | 4  |
|   |   | Yes  |   | 4  | 5  | 4  |
| 41-80 Hours   1-2 Weeks   | Jul 2021 - Dec 2021   | Yes  |   | 4  | 4  | 4  |
|   |   | No   |   |  |  |  |
|   |   | No   |   |  |  |  |
| 321-480 Hours   8-12 Weeks  | Jul 2021 - Dec 2021; Jan 2022 - Present   | Yes  |   | 2  | 4  | 3  |
|   |   | Yes  |   | 3  | 3  | 3  |
|   |   | Yes  |   | 3  | 5  | 3  |
| 41-80 Hours   1-2 Weeks   | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | Yes  |   | 4  | 3  | 2  |
| 321-480 Hours   8-12 Weeks  | Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present                      | Yes  |   | 3  | 3  | 3  |
| 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 3  | 3  | 5  |
|   |   | No   |   |  |  |  |
| 161-320 Hours   4-8 Weeks   | Jan 2022 - Present  | Yes  |   | 3  | 4  | 3  |
|   |   | No   |   |  |  |  |
| 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 4  | 4  | 4  |
| 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | No   |   |  |  |  |
| 481+ Hours   12+ Weeks  | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | Yes  |   | 5  | 5  | 5  |
| 321-480 Hours   8-12 Weeks  | Jan 2021 - Jun 2021   | Yes  |   | 3  | 4  | 3  |
| 81-160 Hours   2-4 Weeks  | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | Yes  |   | 4  | 4  | 4  |
|   |   | Yes  |   | 1  | 4  | 4  |

|                         |                     |     |   |   |   |   |
|-------------------------|---------------------|-----|---|---|---|---|
|                         |                     | No  |   |   |   |   |
|                         |                     | No  |   |   |   |   |
| 41-80 Hours   1-2 Weeks | Jul 2021 - Dec 2021 | Yes | 3 | 3 | 3 | 3 |



| Output from the activities could contribute to form the basis for a sustainable source of revenue for your company. | To the best of your ability, estimate the total number of hours you've committed to the activities. | During which periods of time did you participate in the activities?   | Have you in any capacity contributed to activities relevant to innovation with vertical industry stakeholders? | The activities were executed in accordance with your company's preferences, and not primarily driven by external factors such as deadlines. | Output from the activities was useful to your company. | Output from the activities was useful to other companies in the inter-organizational research- and innovation project. |   |
|---|---|---|--|---|--|--|---|
| 4   | 161-320 Hours   4-8 Weeks   | Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present   | Yes  |   | 3  | 4  | 4 |
|   |   |   | No   |   |  |  |   |
| 3   | 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 5  | 5  | 5 |
| 3   | 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 3  | 3  | 3 |
| 3   | 161-320 Hours   4-8 Weeks   | Jul 2021 - Dec 2021; Jan 2022 - Present   | No   |   |  |  |   |
| 2   | 41-80 Hours   1-2 Weeks   | Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021   | Yes  |   | 3  | 3  | 3 |
|   |   |   | Yes  |   | 5  | 3  | 3 |
| 3   | 481+ Hours   12+ Weeks  | Jan 2022 - Present  | Yes  |   | 3  | 3  | 3 |
| 4   | 81-160 Hours   2-4 Weeks  | Jul 2021 - Dec 2021; Jan 2022 - Present   | Yes  |   | 4  | 5  | 5 |
| 4   | 0-40 Hours   0-1 Week   | Jul 2021 - Dec 2021; Jan 2022 - Present   | No   |   |  |  |   |
| 4   | 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  |   | 4  | 4  | 4 |
|   |   |   |  |   |  |  |   |
| 3   | 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | No   |   |  |  |   |
| 5   | 481+ Hours   12+ Weeks  | Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present                      | Yes  |   | 5  | 5  | 5 |
| 4   | 81-160 Hours   2-4 Weeks  | Jul 2021 - Dec 2021; Jan 2022 - Present   | Yes  |   | 3  | 3  | 4 |
| 4   | 81-160 Hours   2-4 Weeks  | Jul 2021 - Dec 2021; Jan 2022 - Present   | No   |   |  |  |   |
| 4   | 41-80 Hours   1-2 Weeks   | Jul 2021 - Dec 2021; Jan 2022 - Present   | Yes  |   | 2  | 3  | 4 |
| 2   | 0-40 Hours   0-1 Week   | Jan 2022 - Present  | No   |   |  |  |   |
| 5   | 481+ Hours   12+ Weeks  | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | Yes  |   | 4  | 4  | 3 |
| 4   | 41-80 Hours   1-2 Weeks   | Jul 2021 - Dec 2021   | No   |   |  |  |   |
|   |   |   | No   |   |  |  |   |
|   |   |   | No   |   |  |  |   |
| 4   | 321-480 Hours   8-12 Weeks  | Jul 2021 - Dec 2021; Jan 2022 - Present   | No   |   |  |  |   |
|   |   |   |  |   |  |  |   |
| 3   | 0-40 Hours   0-1 Week   | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021                     | No   |   |  |  |   |
| 3   | 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021                     | Yes  |   | 2  | 2  | 3 |
| 2   | 41-80 Hours   1-2 Weeks   | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | Yes  |   | 5  | 4  | 4 |
|   |   |   |  |   |  |  |   |
| 3   | 321-480 Hours   8-12 Weeks  | Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present                      | No   |   |  |  |   |
| 3   | 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | No   |   |  |  |   |
|   |   |   |  |   |  |  |   |
| 4   | 161-320 Hours   4-8 Weeks   | Jan 2022 - Present  | No   |   |  |  |   |
|   |   |   | No   |   |  |  |   |
| 4   | 161-320 Hours   4-8 Weeks   | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | No   |   |  |  |   |
|   |   |   |  |   |  |  |   |
|   |   |   | No   |   |  |  |   |
| 4   | 321-480 Hours   8-12 Weeks  | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | No   |   |  |  |   |
| 5   | 161-320 Hours   4-8 Weeks   | Jul 2020 - Dec 2020   | Yes  |   | 4  | 4  | 5 |
| 4   | 81-160 Hours   2-4 Weeks  | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | No   |   |  |  |   |
| 4   | 481+ Hours   12+ Weeks  | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | Yes  |   | 1  | 4  | 4 |

|  |                           |                     |     |  |   |   |   |
|--|---------------------------|---------------------|-----|--|---|---|---|
|  |                           |                     | Yes |  | 4 | 4 | 5 |
|  |                           |                     | No  |  |   |   |   |
|  | 3 41-80 Hours   1-2 Weeks | Jan 2021 - Jun 2021 | Yes |  | 5 | 5 | 5 |

| Sufficient resources, internal to your company, were made available to perform the activities. | Output from the activities could contribute to form the basis for a sustainable source of revenue for your company. | To the best of your ability, estimate the total number of hours you've committed to the activities. | During which periods of time did you participate in the activities?   | Have you in any capacity contributed to activities relevant to innovation with vertical industry stakeholders? | The activities were executed in accordance with your company's preferences, and not primarily driven by external factors such as deadlines. | Output from the activities was useful to your company. |
|--|---|---|---|--|---|--|
| 3  | 4   | 161-320 Hours   4-8 Weeks   | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | Yes  | 3   | 4  |
|  |   |   |   | Yes  | 4   | 5  |
| 5  | 5   | 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | No   |   |  |
| 4  | 4   | 321-480 Hours   8-12 Weeks  | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2021 - Dec 2021   | No   |   |  |
|  |   |   |   | No   |   |  |
| 3  | 3   | 161-320 Hours   4-8 Weeks   | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | No   |   |  |
| 4  | 3   | 41-80 Hours   1-2 Weeks   | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | No   |   |  |
| 3  | 3   | 481+ Hours   12+ Weeks  | Jan 2022 - Present  | No   |   |  |
| 4  | 4   | 161-320 Hours   4-8 Weeks   | Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present   | No   |   |  |
|  |   |   |   | No   |   |  |
| 4  | 3   | 161-320 Hours   4-8 Weeks   | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | No   |   |  |
|  |   |   |   | No   |   |  |
|  |   |   |   | No   |   |  |
| 5  | 5   | 481+ Hours   12+ Weeks  | Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present                      | Yes  | 5   | 5  |
| 2  | 3   | 0-40 Hours   0-1 Week   | Jul 2021 - Dec 2021; Jan 2022 - Present   | Yes  | 3   | 3  |
| 4  | 3   | 81-160 Hours   2-4 Weeks  | Jul 2021 - Dec 2021; Jan 2022 - Present   | No   |   |  |
|  |   |   |   | No   |   |  |
| 5  | 3   | 481+ Hours   12+ Weeks  | Jul 2020 - Dec 2020; Jan 2021 - Jun 2021  | Yes  | 4   | 5  |
|  |   |   |   | Yes  | 4   | 4  |
|  |   |   |   | No   |   |  |
|  |   |   |   | No   |   |  |
|  |   |   |   | Yes  | 3   | 3  |
|  |   |   |   | No   |   |  |
| 5  | 2   | 41-80 Hours   1-2 Weeks   | Jun 2019 - Dec 2019; Jul 2021 - Dec 2021  | No   |   |  |
| 5  | 2   | 161-320 Hours   4-8 Weeks   | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | Yes  | 2   | 1  |
|  |   |   |   | No   |   |  |
|  |   |   |   | No   |   |  |
|  |   |   |   | No   |   |  |
|  |   |   |   | No   |   |  |
| 4  | 5   | 41-80 Hours   1-2 Weeks   | Jan 2021 - Jun 2021   | No   |   |  |
|  |   |   |   | Yes  | 2   | 4  |
|  |   |   |   | No   |   |  |
| 4  | 4   | 481+ Hours   12+ Weeks  | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present  | No   |   |  |

|   |   |                            |   |          |   |   |
|---|---|----------------------------|---|----------|---|---|
| 5 | 4 | 481+ Hours   12+ Weeks     | Jun 2019 - Dec 2019; Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021 | No<br>No |   |   |
| 5 | 5 | 321-480 Hours   8-12 Weeks | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021  | Yes      | 4 | 2 |

| Output from the activities was useful to other companies in the inter-organizational research- and innovation project. | Sufficient resources, internal to your company, were made available to perform the activities. | Output from the activities could contribute to form the basis for a sustainable source of revenue for your company. | To the best of your ability, estimate the total number of hours you've committed to the activities. | During which periods of time did you participate in the activities?                                    | Have you in any capacity contributed to activities relevant to innovation with vertical industry stakeholders? | The activities were executed in accordance with your company's preferences, and not primarily driven by external factors such as deadlines. |
|--|--|---|---|--|--|---|
|  |  |   |   |  |  |   |
| 4  | 3  | 4   | 41-80 Hours   1-2 Weeks   | Jul 2021 - Dec 2021; Jan 2022 - Present  | Yes  | 4   |
| 4  | 4  | 3   | 161-320 Hours   4-8 Weeks   | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present   | Yes  | 4   |
|  |  |   |   |  | Yes  | 3   |
|  |  |   |   |  | Yes  | 2   |
|  |  |   |   |  | No   |   |
|  |  |   |   |  | Yes  | 4   |
|  |  |   |   |  | No   |   |
|  |  |   |   |  | Yes  | 3   |
|  |  |   |   |  | Yes  | 4   |
|  |  |   |   |  | Yes  | 3   |
|  |  |   |   |  | No   |   |
|  |  |   |   |  |  |   |
|  |  |   |   |  | Yes  | 4   |
| 5  | 5  | 5   | 481+ Hours   12+ Weeks  | Jan 2020 - Jun 2020; Jul 2020 - Dec 2020; Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present | Yes  | 5   |
| 3  | 3  | 4   | 41-80 Hours   1-2 Weeks   | Jul 2021 - Dec 2021; Jan 2022 - Present  | No   |   |
|  |  |   |   |  | Yes  | 2   |
|  |  |   |   |  | Yes  | 4   |
|  |  |   |   |  | Yes  | 2   |
| 4  | 5  | 5   | 481+ Hours   12+ Weeks  | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021   | Yes  | 5   |
| 4  | 4  | 4   | 0-40 Hours   0-1 Week   | Jul 2021 - Dec 2021  | Yes  | 5   |
|  |  |   |   |  | Yes  | 3   |
|  |  |   |   |  | Yes  | 4   |
| 3  | 3  | 3   | 321-480 Hours   8-12 Weeks  | Jul 2021 - Dec 2021; Jan 2022 - Present  | Yes  | 3   |
|  |  |   |   |  | Yes  | 3   |
|  |  |   |   |  | Yes  | 1   |
| 3  | 4  | 1   | 41-80 Hours   1-2 Weeks   | Jan 2021 - Jun 2021; Jul 2021 - Dec 2021; Jan 2022 - Present   | Yes  | 1   |
|  |  |   |   |  | No   |   |
|  |  |   |   |  | Yes  | 3   |
|  |  |   |   |  | Yes  | 3   |
|  |  |   |   |  | Yes  | 3   |
|  |  |   |   |  | No   |   |
|  |  |   |   |  | Yes  | 4   |
|  |  |   |   |  | No   |   |
| 3  | 4  | 4   | 81-160 Hours   2-4 Weeks  | Jan 2021 - Jun 2021  | Yes  | 4   |
|  |  |   |   |  | No   |   |
|  |  |   |   |  | Yes  | 4   |
|  |  |   |   |  | Yes  | 4   |
|  |  |   |   |  | Yes  | 1   |

|   |   |                         |                     |     |     |   |
|---|---|-------------------------|---------------------|-----|-----|---|
|   |   |                         |                     |     | No  |   |
|   |   |                         |                     |     | Yes | 5 |
| 2 | 3 | 3 0-40 Hours   0-1 Week | Jun 2019 - Dec 2019 | Yes |     | 1 |

| Output from the activities was useful to your company. | Output from the activities was useful to other companies in the inter-organizational research- and innovation project. | Sufficient resources, internal to your company, were made available to perform the activities. | Output from the activities could contribute to form the basis for a sustainable source of revenue for your company. | To the best of your ability, estimate the total number of hours you've committed to the activities. | During which periods of time did you participate in the activities?   | How satisfied are you with the quality of activities performed so far? |
|--|--|--|---|---|---|--|
| 4  | 4  | 3  | 4   | 161-320 Hours   4-8 Weeks   | Jul 2020 - Dec 2020;Jan 2021 - Jun 2021;Jul 2021 - Dec 2021; Jan 2022 - Present   | 4  |
| 4  | 3  | 4  | 2   | 81-160 Hours   2-4 Weeks  | Jan 2021 - Jun 2021;Jul 2021 - Dec 2021;Jan 2022 - Present  | 4  |
| 3  | 3  | 3  | 3   | 161-320 Hours   4-8 Weeks   | Jan 2022 - Present  | 3  |
| 3  | 4  | 4  | 2   | 321-480 Hours   8-12 Weeks  | Jan 2021 - Jun 2021;Jul 2021 - Dec 2021;Jan 2022 - Present  | 4  |
|  |  |  |   |   |   | 2  |
| 4  | 4  | 4  | 2   | 41-80 Hours   1-2 Weeks   | Jan 2021 - Jun 2021   | 3  |
|  |  |  |   |   |   | 4  |
| 3  | 3  | 3  | 3   | 481+ Hours   12+ Weeks  | Jan 2022 - Present  | 3  |
| 5  | 4  | 3  | 3   | 41-80 Hours   1-2 Weeks   | Jan 2021 - Jun 2021;Jul 2021 - Dec 2021   | 3  |
| 3  | 4  | 4  | 3   | 0-40 Hours   0-1 Week   | Jul 2021 - Dec 2021;Jan 2022 - Present  | 4  |
|  |  |  |   |   |   | 4  |
|  |  |  |   |   |   |  |
| 5  | 5  | 5  | 5   | 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019;Jan 2020 - Jun 2020;Jul 2020 - Dec 2020; Jan 2021 - Jun 2021;Jul 2021 - Dec 2021;Jan 2022 - Present | 4  |
| 5  | 5  | 5  | 5   | 481+ Hours   12+ Weeks  | Jan 2020 - Jun 2020;Jul 2020 - Dec 2020;Jan 2021 - Jun 2021; Jul 2021 - Dec 2021;Jan 2022 - Present                     | 4  |
|  |  |  |   |   |   | 3  |
| 3  | 3  | 4  | 3   | 321-480 Hours   8-12 Weeks  | Jan 2021 - Jun 2021;Jul 2021 - Dec 2021;Jan 2022 - Present  | 3  |
| 4  | 3  | 4  | 2   | 0-40 Hours   0-1 Week   | Jul 2021 - Dec 2021   | 3  |
| 4  | 4  | 4  | 2   | 0-40 Hours   0-1 Week   | Jan 2022 - Present  | 4  |
| 4  | 5  | 5  | 5   | 481+ Hours   12+ Weeks  | Jul 2021 - Dec 2021;Jan 2022 - Present  | 4  |
| 5  | 5  | 5  | 5   | 81-160 Hours   2-4 Weeks  | Jul 2021 - Dec 2021   | 4  |
| 5  | 5  | 5  | 4   | 0-40 Hours   0-1 Week   | Jul 2021 - Dec 2021   | 5  |
| 4  | 3  | 3  | 3   | 0-40 Hours   0-1 Week   | Jan 2022 - Present  | 4  |
| 3  | 3  | 3  | 3   | 481+ Hours   12+ Weeks  | Jan 2022 - Present  | 3  |
|  |  |  |   |   |   |  |
| 5  | 5  | 5  | 4   | 0-40 Hours   0-1 Week   | Jun 2019 - Dec 2019;Jan 2020 - Jun 2020;Jul 2020 - Dec 2020; Jan 2021 - Jun 2021;Jul 2021 - Dec 2021;Jan 2022 - Present | 4  |
| 3  | 3  | 5  | 3   | 321-480 Hours   8-12 Weeks  | Jun 2019 - Dec 2019;Jan 2020 - Jun 2020;Jul 2020 - Dec 2020; Jan 2021 - Jun 2021;Jul 2021 - Dec 2021                    | 3  |
| 2  | 2  | 4  | 1   | 41-80 Hours   1-2 Weeks   | Jan 2021 - Jun 2021;Jul 2021 - Dec 2021;Jan 2022 - Present  | 4  |
|  |  |  |   |   |   | 3  |
| 3  | 5  | 5  | 2   | 0-40 Hours   0-1 Week   | Jan 2021 - Jun 2021;Jul 2021 - Dec 2021   | 3  |
| 5  | 5  | 5  | 5   | 481+ Hours   12+ Weeks  | Jun 2019 - Dec 2019;Jan 2020 - Jun 2020;Jan 2021 - Jun 2021; Jul 2021 - Dec 2021;Jan 2022 - Present                     | 5  |
| 4  | 5  | 4  | 3   | 0-40 Hours   0-1 Week   | Jan 2022 - Present  | 4  |
|  |  |  |   |   |   | 4  |
| 4  | 4  | 4  | 4   | 41-80 Hours   1-2 Weeks   | Jan 2020 - Jun 2020;Jul 2020 - Dec 2020;Jan 2021 - Jun 2021; Jul 2021 - Dec 2021  | 4  |
|  |  |  |   |   |   | 4  |
| 5  | 4  | 4  | 4   | 321-480 Hours   8-12 Weeks  | Jun 2019 - Dec 2019;Jan 2020 - Jun 2020;Jul 2020 - Dec 2020; Jan 2021 - Jun 2021;Jul 2021 - Dec 2021;Jan 2022 - Present | 4  |
|  |  |  |   |   |   | 4  |
| 4  | 4  | 4  | 4   | 81-160 Hours   2-4 Weeks  | Jan 2021 - Jun 2021;Jul 2021 - Dec 2021;Jan 2022 - Present  | 4  |
|  |  |  |   |   |   | 4  |
| 5  | 5  | 5  | 5   | 321-480 Hours   8-12 Weeks  | Jun 2019 - Dec 2019;Jan 2020 - Jun 2020;Jul 2020 - Dec 2020; Jan 2021 - Jun 2021;Jul 2021 - Dec 2021;Jan 2022 - Present | 4  |







|  |                     |                            |                   |                   |                   |                |
|--|---------------------|----------------------------|-------------------|-------------------|-------------------|----------------|
|  |                     |                            |                   |                   |                   |                |
|  | 2 Somewhat agree    | Somewhat disagree          | Strongly disagree | Strongly disagree | Somewhat disagree | Strongly agree |
|  | 3 Somewhat disagree | Strongly disagree          | Somewhat disagree | Strongly disagree | Somewhat disagree | Strongly agree |
|  | 4 Somewhat agree    | Neither agree nor disagree | Somewhat agree    | Strongly disagree | Somewhat disagree | Somewhat agree |

| What was the intentions of participating in an inter-organizational research- and innovation project?: Increasing knowledge of relevant technology and industry domain insight | What was the intentions of participating in an inter-organizational research- and innovation project?: Increasing skills in how to participate in large research- and innovation consortiums | What was the intentions of participating in an inter-organizational research- and innovation project?: Learning to know (i.e. networking with-) other industry partners | What was the intentions of participating in an inter-organizational research- and innovation project?: Gain access to funding from the research- and innovation project | What was the intentions of participating in an inter-organizational research- and innovation project?: Position to gain access to funding from future research- and innovation projects | Based on activities performed so far in an inter-organizational research- and innovation project, what have been the positive outcomes for your company?: Increased research- and innovation competence/experience | Based on activities performed so far in an inter-organizational research- and innovation project, what have been the positive outcomes for your company?: Increased knowledge of relevant technology and industry domain insight |
|--|--|---|---|---|--|--|
| Strongly agree   | Neither agree nor disagree   | Strongly agree  | Somewhat agree  | Somewhat agree  | Strongly agree   | Strongly agree   |
| Somewhat agree   | Strongly disagree  | Strongly agree  | Somewhat agree  | Somewhat agree  | Somewhat agree   | Neither agree nor disagree   |
| Strongly agree   | Strongly agree   | Strongly agree  | Strongly agree  | Strongly agree  | Somewhat agree   | Somewhat agree   |
| Strongly agree   | Strongly agree   | Strongly agree  | Strongly agree  | Somewhat agree  | Strongly agree   | Strongly agree   |
| Somewhat agree   | Neither agree nor disagree   | Neither agree nor disagree  | Neither agree nor disagree  | Neither agree nor disagree  | Somewhat agree   | Somewhat agree   |
| Strongly agree   | Somewhat agree   | Somewhat agree  | Somewhat disagree   | Somewhat disagree   | Somewhat agree   | Somewhat agree   |
| Strongly agree   | Somewhat agree   | Strongly agree  | Neither agree nor disagree  | Somewhat agree  | Somewhat agree   | Strongly agree   |
| Somewhat agree   | Somewhat agree   | Neither agree nor disagree  | Somewhat agree  | Somewhat agree  | Somewhat agree   | Somewhat agree   |
| Strongly agree   | Somewhat agree   | Somewhat agree  | Neither agree nor disagree  | Somewhat agree  | Somewhat agree   | Strongly agree   |
| Neither agree nor disagree   | Somewhat agree   | Somewhat agree  | Neither agree nor disagree  | Neither agree nor disagree  | Somewhat agree   | Neither agree nor disagree   |
| Strongly agree   | Strongly agree   | Strongly agree  | Strongly agree  | Strongly agree  | Somewhat agree   | Neither agree nor disagree   |
|  |  |   |   |   |  |  |
|  |  |   |   |   |  |  |
| Somewhat agree   | Somewhat agree   | Strongly agree  | Strongly agree  | Strongly agree  | Strongly agree   | Strongly agree   |
| Somewhat agree   | Somewhat agree   | Somewhat agree  | Somewhat agree  | Somewhat agree  | Somewhat agree   | Somewhat agree   |
| Neither agree nor disagree   | Somewhat agree   | Strongly agree  | Somewhat agree  | Somewhat agree  | Strongly agree   | Strongly agree   |
| Somewhat agree   | Strongly agree   | Strongly agree  | Neither agree nor disagree  | Neither agree nor disagree  | Strongly agree   | Strongly agree   |
| Strongly agree   | Somewhat disagree  | Neither agree nor disagree  | Somewhat agree  | Somewhat agree  | Strongly disagree  | Strongly disagree  |
| Strongly agree   | Strongly agree   | Strongly agree  | Strongly agree  | Strongly agree  | Strongly agree   | Strongly agree   |
| Strongly agree   | Neither agree nor disagree   | Strongly agree  | Neither agree nor disagree  | Somewhat agree  | Strongly agree   | Strongly agree   |
| Somewhat agree   | Somewhat agree   | Somewhat agree  | Somewhat agree  | Somewhat agree  | Somewhat agree   | Somewhat agree   |
| Strongly agree   | Strongly agree   | Somewhat agree  | Neither agree nor disagree  | Neither agree nor disagree  | Somewhat agree   | Somewhat agree   |
| Strongly agree   | Strongly agree   | Strongly agree  | Strongly agree  | Somewhat agree  | Strongly agree   | Strongly agree   |
| Strongly agree   | Somewhat agree   | Somewhat agree  | Somewhat agree  | Somewhat agree  | Somewhat agree   | Somewhat agree   |
|  |  |   |   |   |  |  |
| Strongly agree   | Somewhat agree   | Somewhat agree  | Somewhat agree  | Strongly agree  | Somewhat agree   | Somewhat agree   |
| Strongly agree   | Strongly agree   | Neither agree nor disagree  | Somewhat disagree   | Somewhat disagree   | Somewhat agree   | Strongly agree   |
| Neither agree nor disagree   | Somewhat agree   | Somewhat disagree   | Strongly agree  | Strongly agree  | Somewhat agree   | Neither agree nor disagree   |
| Neither agree nor disagree   | Neither agree nor disagree   | Neither agree nor disagree  | Neither agree nor disagree  | Neither agree nor disagree  | Neither agree nor disagree   | Neither agree nor disagree   |
| Strongly agree   | Strongly agree   | Strongly agree  | Strongly agree  | Strongly agree  | Strongly agree   | Strongly agree   |
|  |  |   |   |   |  |  |
| Strongly agree   | Strongly agree   | Somewhat agree  | Somewhat agree  | Strongly agree  | Strongly agree   | Strongly agree   |
| Somewhat agree   | Neither agree nor disagree   | Somewhat agree  | Neither agree nor disagree  | Neither agree nor disagree  | Somewhat agree   | Somewhat agree   |
| Strongly agree   | Somewhat agree   | Somewhat agree  | Somewhat agree  | Somewhat agree  | Somewhat agree   | Somewhat agree   |
| Strongly agree   | Somewhat agree   | Strongly agree  | Somewhat agree  | Neither agree nor disagree  | Strongly agree   | Strongly agree   |
| Strongly agree   | Strongly agree   | Strongly agree  | Strongly agree  | Strongly agree  | Strongly agree   | Strongly agree   |
| Strongly agree   | Strongly disagree  | Neither agree nor disagree  | Strongly agree  | Strongly agree  | Somewhat agree   | Strongly agree   |
| Neither agree nor disagree   | Neither agree nor disagree   | Somewhat agree  | Somewhat disagree   | Neither agree nor disagree  | Neither agree nor disagree   | Somewhat disagree  |
| Strongly agree   | Neither agree nor disagree   | Neither agree nor disagree  | Somewhat agree  | Somewhat agree  | Strongly agree   | Strongly agree   |
| Strongly agree   | Strongly agree   | Strongly agree  | Somewhat agree  | Somewhat agree  | Strongly agree   | Strongly agree   |

|                            |                            |                   |                |                |                |                |
|----------------------------|----------------------------|-------------------|----------------|----------------|----------------|----------------|
| Strongly agree             | Strongly agree             | Somewhat agree    | Strongly agree | Somewhat agree | Strongly agree | Somewhat agree |
| Neither agree nor disagree | Somewhat agree             | Strongly agree    | Strongly agree | Strongly agree | Strongly agree | Somewhat agree |
| Strongly agree             | Neither agree nor disagree | Somewhat disagree | Somewhat agree | Strongly agree | Strongly agree | Strongly agree |

| Based on activities performed so far in an inter-organizational research- and innovation project, what have been the positive outcomes for your company?: Increased skills in how to participate in large research- and innovation consortiums | Based on activities performed so far in an inter-organizational research- and innovation project, what have been the positive outcomes for your company?: Learned to know (i. e. networking with-) other industry partners | Based on activities performed so far in an inter-organizational research- and innovation project, what have been the positive outcomes for your company?: Gained access to funding from the research- and innovation project | Based on activities performed so far in an inter-organizational research- and innovation project, what have been the positive outcomes for your company?: Positioned to gain access to funding from future research- and innovation projects | Based on the activities performed so far in an inter-organizational research- and innovation project, what are your suggestions for improvement of the work done?: More focus on the need, customer and market assessment | Based on the activities performed so far in an inter-organizational research- and innovation project, what are your suggestions for improvement of the work done?: More focus on technical trials and testing of industry technology/service concepts/solutions | Based on the activities performed so far in an inter-organizational research- and innovation project, what are your suggestions for improvement of the work done?: More focus on business and social acceptance of technology/service concepts/solution validation and commercialization |
|--|--|--|--|---|---|--|
| Strongly agree   | Strongly agree   | Strongly agree   | Somewhat agree   | Somewhat agree  | Strongly agree  | Somewhat agree   |
| Strongly disagree  | Somewhat agree   | Strongly agree   | Strongly agree   | Somewhat agree  | Neither agree nor disagree  | Somewhat agree   |
| Somewhat agree   | Somewhat agree   | Somewhat agree   | Somewhat agree   | Somewhat disagree   | Somewhat disagree   | Somewhat disagree  |
| Strongly agree   | Strongly agree   | Strongly agree   | Strongly agree   | Somewhat agree  | Strongly agree  | Strongly agree   |
| Somewhat agree   | Somewhat agree   | Somewhat agree   | Neither agree nor disagree   | Neither agree nor disagree  | Somewhat agree  | Neither agree nor disagree   |
| Strongly agree   | Somewhat agree   | Strongly agree   | Neither agree nor disagree   | Somewhat agree  | Somewhat agree  | Strongly agree   |
| Somewhat agree   | Strongly agree   | Neither agree nor disagree   | Somewhat agree   | Neither agree nor disagree  | Neither agree nor disagree  | Neither agree nor disagree   |
| Somewhat agree   | Somewhat agree   | Somewhat agree   | Somewhat agree   | Somewhat agree  | Somewhat agree  | Somewhat agree   |
| Neither agree nor disagree   | Somewhat agree   | Somewhat agree   | Neither agree nor disagree   | Somewhat agree  | Strongly agree  | Neither agree nor disagree   |
| Neither agree nor disagree   | Somewhat agree   | Somewhat agree   | Neither agree nor disagree   | Somewhat agree  | Somewhat agree  | Neither agree nor disagree   |
| Somewhat agree   | Somewhat agree   | Somewhat agree   | Somewhat agree   | Strongly agree  | Somewhat agree  | Neither agree nor disagree   |
|  |  |  |  |   |   |  |
|  |  |  |  |   |   |  |
| Strongly agree   | Strongly agree   | Strongly agree   | Strongly agree   | Somewhat agree  | Neither agree nor disagree  | Neither agree nor disagree   |
| Somewhat agree   | Somewhat agree   | Somewhat agree   | Somewhat agree   | Somewhat agree  | Somewhat agree  | Neither agree nor disagree   |
| Somewhat agree   | Strongly agree   | Somewhat agree   | Somewhat agree   | Neither agree nor disagree  | Neither agree nor disagree  | Somewhat agree   |
| Strongly agree   | Strongly agree   | Strongly agree   | Strongly agree   | Strongly agree  | Strongly agree  | Strongly agree   |
| Somewhat disagree  | Somewhat disagree  | Somewhat disagree  | Neither agree nor disagree   | Somewhat agree  | Somewhat agree  | Somewhat agree   |
| Strongly agree   | Strongly agree   | Strongly agree   | Strongly agree   | Neither agree nor disagree  | Strongly agree  | Somewhat agree   |
| Neither agree nor disagree   | Somewhat agree   | Neither agree nor disagree   | Somewhat agree   | Somewhat agree  | Somewhat agree  | Strongly agree   |
| Somewhat agree   | Somewhat agree   | Somewhat agree   | Somewhat agree   | Somewhat agree  | Somewhat agree  | Somewhat agree   |
| Strongly agree   | Strongly agree   | Neither agree nor disagree   | Neither agree nor disagree   | Somewhat agree  | Strongly agree  | Strongly agree   |
| Strongly agree   | Strongly agree   | Strongly agree   | Strongly agree   | Somewhat agree  | Neither agree nor disagree  | Somewhat agree   |
| Strongly agree   | Strongly agree   | Somewhat agree   | Strongly agree   | Strongly agree  | Somewhat agree  | Somewhat agree   |
|  |  |  |  |   |   |  |
| Somewhat agree   | Somewhat agree   | Somewhat agree   | Strongly agree   | Somewhat agree  | Somewhat agree  | Strongly agree   |
| Somewhat agree   | Somewhat agree   | Neither agree nor disagree   | Neither agree nor disagree   | Somewhat agree  | Somewhat agree  | Somewhat agree   |
| Somewhat agree   | Somewhat agree   | Somewhat agree   | Neither agree nor disagree   | Neither agree nor disagree  | Somewhat agree  | Neither agree nor disagree   |
| Neither agree nor disagree   | Neither agree nor disagree   | Neither agree nor disagree   | Neither agree nor disagree   | Neither agree nor disagree  | Neither agree nor disagree  | Neither agree nor disagree   |
| Strongly agree   | Strongly agree   | Strongly agree   | Strongly agree   | Neither agree nor disagree  | Strongly agree  | Neither agree nor disagree   |
| Strongly agree   | Strongly agree   | Strongly agree   | Strongly agree   | Somewhat agree  | Somewhat agree  | Neither agree nor disagree   |
| Neither agree nor disagree   | Somewhat agree   | Neither agree nor disagree   | Neither agree nor disagree   | Somewhat disagree   | Somewhat agree  | Somewhat disagree  |
| Somewhat agree   | Neither agree nor disagree   | Neither agree nor disagree   | Neither agree nor disagree   | Strongly agree  | Strongly agree  | Somewhat agree   |
| Neither agree nor disagree   | Somewhat agree   | Somewhat agree   | Neither agree nor disagree   | Somewhat agree  | Somewhat agree  | Neither agree nor disagree   |
| Strongly agree   | Somewhat agree   | Strongly agree   | Strongly agree   | Strongly agree  | Neither agree nor disagree  | Somewhat agree   |
| Somewhat agree   | Somewhat agree   | Strongly agree   | Somewhat agree   | Strongly agree  | Strongly agree  | Somewhat agree   |
| Strongly disagree  | Somewhat agree   | Somewhat agree   | Somewhat agree   | Somewhat disagree   | Somewhat agree  | Neither agree nor disagree   |
| Somewhat agree   | Somewhat agree   | Somewhat agree   | Somewhat agree   | Somewhat agree  | Somewhat agree  | Neither agree nor disagree   |
| Neither agree nor disagree   | Neither agree nor disagree   | Neither agree nor disagree   | Neither agree nor disagree   | Neither agree nor disagree  | Somewhat agree  | Strongly agree   |

|                            |                            |                |                |                |                   |                            |
|----------------------------|----------------------------|----------------|----------------|----------------|-------------------|----------------------------|
| Neither agree nor disagree | Neither agree nor disagree | Strongly agree | Strongly agree | Somewhat agree | Somewhat disagree | Somewhat agree             |
| Somewhat agree             | Somewhat agree             | Strongly agree | Strongly agree | Strongly agree | Somewhat agree    | Neither agree nor disagree |
| Somewhat agree             | Somewhat agree             | Somewhat agree | Strongly agree | Strongly agree | Somewhat disagree | Strongly agree             |

| Based on the activities performed so far in an inter-organizational research- and innovation project, what are your suggestions for improvement of the work done?: More collaboration with large corporations in the consortium regarding joint work with commercialization | Based on the activities performed so far in an inter-organizational research- and innovation project, what are your suggestions for improvement of the work done?: More collaboration with SME's regarding joint with the user requirements and design of the concept/solution | Based on the activities performed so far in an inter-organizational research- and innovation project, what are your suggestions for improvement of the work done?: More focus on collaboration with academic and research institute partners in the consortium for joint publication and dissemination | Based on the activities performed so far in an inter-organizational research- and innovation project, what are your suggestions for improvement of the work done?: More time and resources spent on the initial deliverables in the project (as a means to better facilitate later activities) |
|---|--|--|--|
|   |  |  |  |
| Somewhat agree  | Somewhat agree   | Somewhat agree   | Neither agree nor disagree   |
| Neither agree nor disagree  | Somewhat agree   | Neither agree nor disagree   | Neither agree nor disagree   |
|   |  |  |  |
| Somewhat agree  | Somewhat agree   | Strongly agree   | Somewhat disagree  |
|   |  |  |  |
| Somewhat agree  | Strongly agree   | Strongly agree   | Somewhat agree   |
| Neither agree nor disagree  | Neither agree nor disagree   | Neither agree nor disagree   | Neither agree nor disagree   |
|   |  |  |  |
| Strongly agree  | Neither agree nor disagree   | Somewhat agree   | Somewhat agree   |
|   |  |  |  |
| Somewhat agree  | Somewhat agree   | Somewhat agree   | Neither agree nor disagree   |
| Strongly agree  | Strongly agree   | Neither agree nor disagree   | Neither agree nor disagree   |
|   |  |  |  |
| Somewhat agree  | Strongly agree   | Neither agree nor disagree   | Somewhat agree   |
| Neither agree nor disagree  | Somewhat agree   | Somewhat agree   | Somewhat agree   |
|   |  |  |  |
| Strongly agree  | Strongly agree   | Neither agree nor disagree   | Strongly agree   |
|   |  |  |  |
|   |  |  |  |
|   |  |  |  |
| Somewhat agree  | Neither agree nor disagree   | Strongly agree   | Somewhat agree   |
|   |  |  |  |
| Somewhat agree  | Somewhat agree   | Somewhat agree   | Neither agree nor disagree   |
|   |  |  |  |
| Neither agree nor disagree  | Neither agree nor disagree   | Neither agree nor disagree   | Neither agree nor disagree   |
| Strongly agree  | Strongly agree   | Strongly agree   | Strongly agree   |
| Neither agree nor disagree  | Neither agree nor disagree   | Neither agree nor disagree   | Neither agree nor disagree   |
| Somewhat agree  | Somewhat agree   | Somewhat agree   | Neither agree nor disagree   |
| Neither agree nor disagree  | Neither agree nor disagree   | Somewhat agree   | Somewhat disagree  |
| Somewhat agree  | Somewhat agree   | Somewhat agree   | Somewhat agree   |
| Strongly agree  | Somewhat agree   | Strongly agree   | Somewhat agree   |
| Strongly agree  | Strongly agree   | Strongly agree   | Somewhat agree   |
| Somewhat agree  | Strongly agree   | Strongly agree   | Somewhat agree   |
|   |  |  |  |
|   |  |  |  |
| Somewhat agree  | Strongly agree   | Somewhat agree   | Somewhat agree   |
|   |  |  |  |
| Neither agree nor disagree  | Strongly agree   | Strongly agree   | Strongly disagree  |
| Strongly agree  | Strongly agree   | Strongly agree   | Strongly agree   |
|   |  |  |  |
| Neither agree nor disagree  | Neither agree nor disagree   | Neither agree nor disagree   | Neither agree nor disagree   |
|   |  |  |  |
| Neither agree nor disagree  | Neither agree nor disagree   | Neither agree nor disagree   | Neither agree nor disagree   |
|   |  |  |  |
| Somewhat agree  | Somewhat agree   | Strongly agree   | Somewhat agree   |
| Neither agree nor disagree  | Somewhat agree   | Strongly disagree  | Somewhat disagree  |
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| Neither agree nor disagree  | Neither agree nor disagree   | Neither agree nor disagree   | Somewhat agree   |
| Somewhat disagree   | Neither agree nor disagree   | Somewhat agree   | Somewhat agree   |
| Neither agree nor disagree  | Neither agree nor disagree   | Neither agree nor disagree   | Neither agree nor disagree   |
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| Somewhat agree             | Somewhat agree | Somewhat disagree          | Neither agree nor disagree |
| Neither agree nor disagree | Strongly agree | Neither agree nor disagree | Somewhat agree             |
| Neither agree nor disagree | Strongly agree | Neither agree nor disagree | Strongly agree             |



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## D TIØ4562 Deliverable

The following document was the authors deliverable for the NTNU course "TIØ4562 - Strategy, Innovation and International Business Development, Specialization Project" (Opsahl, 2021).

TIØ4562 - Strategy, Innovation and  
International Business Development,  
Specialization Project

The usage of Lean Startup-methodology  
in the context of helix innovation  
models

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Supervisor: Per Jonny Nesse

2021-12-16

# 1 PREFACE

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This article is a deliverable in the course *TIØ4562 – Strategy, Innovation and International Business Development, Specialization Project* at the Norwegian University of Science and Technology. In the context of the course, the article's purpose is to (demonstrate my ability to) analyze and solve problems related to the strategy and development of an enterprise's international business activities.

I would like to thank my supervisor, Per Jonny Nesse, for his help during the semester.

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### 3 ABSTRACT

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The purpose of this paper is to determine the viability of employing the Lean Start-up methodology in innovation ecosystems with actors from public education, to improve the rate of commercialization. To this end, a structured literature review was conducted, aiming to answer the following research questions: “How can open and disruptive innovation projects benefit start-ups and SMEs in different phases?” and “How is Lean Startup-methodology applied during disruptive innovation projects with multiple business ecosystem partners?”. There were no conclusive findings to either question. Collaborative innovation is valuable to SMEs in many situations, but its impact in different phases of market entry was indeterminable. Lean Startup-methodology is potentially an improvement over existing innovation practices in innovation ecosystems and is an area that warrants further research.

## 4 INTRODUCTION

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Since Henry William Chesbrough (2003) introduced the concept of open innovation, there has been a steadily increasing amount of research published on the topic. Some articles point out however that most of the research is concerned with the role of multinational corporations, and not so much is directed at understanding the role of their collaborative innovation partners. Still (2017) found that early phases in the innovation framework known as “The Lean Start-up” (Ries, 2011) are regularly practiced in the context of university research, but that practices from the commercialization phases had not gained much ground in the space of research innovation. Carayannis et al. (2021) describe the triple-, quadruple and quintuple innovation helixes, which describes a process of collaboration between the education system, economic system, natural environment, media- and culture-based public, and political system.

The topic of this study then is to determine the viability of extending Lean Start-up practices into the commercialization phase for innovation processes happening in the public education system e.g., universities, by means of open innovation and either of the triple-, quadruple-, or quintuple helixes of innovation.

To that end a structured literature study was conducted to answer the following research questions:

- How can disruptive and inbound open innovation projects benefit start-ups and SMEs in different phases?
- How is Lean Startup-methodology applied during disruptive innovation projects with multiple business ecosystem partners?

Seeing as this paper is written in the context of a university course leading up to a master thesis, a core motivation in addition to answering the research questions is to identify relevant areas in need of further research.

### 4.1 STRUCTURE

The paper is split into the following sections, in order of appearance: Theory, in which theoretical concepts important to the literature review are explained. Methodology, in which the search strategy is explained. Results, in which the reviewed articles are presented. Discussion, in which the presented articles are discussed in the context of the research questions. Limitations, in which uncertainties about the paper are described. And finally, the conclusion, which seeks to succinctly answer the research questions and the stated purpose of the paper.

## 5 THEORY

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This section introduces theoretical concepts needed to avoid ambiguities in the results section, or that are important, but not otherwise referenced.

The open innovation model (Henry William Chesbrough, 2003) describes an innovation paradigm where “a company commercializes both its own ideas as well as innovations from other firms and seeks ways to bring its in-house ideas to market by deploying pathways outside its current businesses.” (H. W. Chesbrough, 2003)

Absorptive capacity, defined by Cohen and Levinthal (1990), is “an organization’s ability to identify, assimilate, transform, and use external knowledge, research and practice.” (What is absorptive capacity? The definition and an explanation).

The Lean Startup (Ries, 2011) is about using iterative processes, inspired by agile, lean, design thinking, and the scientific method to quickly and cheaply turn innovations into commercially viable products. Important concepts include the “build, measure, learn”-loop, where an entrepreneur will loop over three phases to learn about his product and market. In essence, you formulate a hypothesis, build a product to test it, measure results, learn, and repeat.

The helix models of innovation describe how innovation happens in tandem across different classes of societal institutions, including but not limited to private enterprises and public research institutions (Carayannis et al., 2021).

## 6 METHODOLOGY

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Figure 2 in “Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review ” (Tranfield et al., 2003) describes the stages of a systematic review, and was the basis for the methodology applied during this literature study. The research questions were decided first, then the literature to be reviewed was identified by searching in the online database Scopus. A query was devised to maximize the likelihood of producing scientific articles relevant to the research questions, and then the results were algorithmically filtered to produce the final list of articles to review.

The query was built to produce articles pertaining to open innovation or innovation ecosystems or articles mentioning all three of small firms, large firms, and innovation in their title or abstract. As additional constraints, the articles had to be finalized, be published in a scientific journal, and be written in English. To limit the search to include less articles while still capturing major development in recent years, the query was executed five times, but with the additional constraint that each iteration must only contain articles published in the same calendar year. This was done for the years 2017-2021, inclusive.

The final query looked like this for the year 2021 and was repeated a total of five times with “2021” replaced with the appropriate year:

```
(( TITLE-ABS (( "Innovation ecosystem") OR ("Open Innovation") OR (( innovat* AND ( corporation?  
OR mnc? ) AND ( startup? OR smb? OR sme? ))))) AND ( LIMIT-TO ( PUBSTAGE , "final" )) AND ( LIMIT-TO ( DOCTYPE , "ar" )) AND ( LIMIT-TO ( PUBYEAR , 2021 )) AND ( LIMIT-TO ( LANGUAGE , "English" ))
```

When the list of articles was finalized on 2021-12-07, the query yielded 3404 total results before constraining year of publication. 503 results for 2021, 487 results for 2020, 372 results for 2019, 338 results for 2018 and 315 results for 2017.

Finally, the 20 most cited articles for each calendar year were put on a shortlist, and articles on the shortlist where EndNote was able to produce the full text were included in the final selection for the literature study.

Lastly, the essential contents of each article were determined, before the findings relevant to the research questions were synthesized in that context.



## 7 RESULTS

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The following section contains presentations of the articles found by executing the previously detailed search strategy. The presentations will form the basis for analysis and discussion in later sections, and so the primary concern is highlighting the parts and metadata of each article that can in some way serve as means to that end. As such, each article will be contextualized by its stated purpose, but the emphasis will be on identifying findings that are relevant to the research questions of this article. Finally, a comment will where applicable be made about the method, and data sources used. The article presentations are organized into buckets by year of publications, which are then internally sorted by author name.

### 7.1 PRESENTATION OF ARTICLES

Ahn et al. (2017) examine the relationship between CEO characteristics and the adoption of open innovation in SMEs. The research is based on a survey of CEOs in Korean SMEs. The results show that positive attitude, entrepreneurial orientation, patience, and education in CEOs can play important roles in facilitating open innovation in SMEs. However, the paper also observed that the important characteristics facilitate different modes of open innovation, suggesting that an organization should pursue broad coverage of relevant characteristics in the management team to maximize the probability of successfully implementing open innovation.

Bogers et al. (2017) give an overview of open innovation as an academic field and suggests avenues of further research on different levels of analysis. The is a narrative literature review and proposes areas of future research.

Martinez-Conesa et al. (2017) examine the role of knowledge management capability as a prerequisite for open innovation in SMEs. The results show that SMEs' operational practices in relation to IT and HR are contributing factors to successful knowledge management, which in turn positively facilitates the implementation of open innovation environments. The relevant organizational units contribute both by existing but also by thoroughly integrating with core operations. SMEs were furthermore found to benefit from commitment-based rather than transactionally oriented HR practices. The study used questionnaire data from 3000 Spanish manufacturing SMEs.

Santoro et al. (2017) examine the role of external knowledge for innovation in the food and beverage industry. The study was conducted based on data from 157 Italian food and beverage firms. Their results showed a connection to market-sourced knowledge for incremental innovation and science-sourced knowledge for disruptive innovation by analyzing the economic performance of new product developments. Additionally, the study found a positive connection between the resources spent on innovation and the firm's capacity for absorbing external knowledge.

Scuotto et al. (2017) aim to determine SME preferences with regards to open innovation, based on their characteristics as seen through the lens of the knowledge-based view. The study was conducted with a questionnaire, distributed to 175 SMEs in the United Kingdom. The authors found the knowledge-driven approach to be a dominating factor, such that the SMEs preferred informal inbound modes of open innovation.

Usman and Vanhaverbeke (2017) examine how start-ups interface with large companies in the context of open innovation, emphasizing the start-up perspective. The study is a case study, with one case for inbound- and outbound open innovation, respectively, and seeks to both identify challenges and factors for success. The results show that challenges for the start-up generally revolve around limitations on resources available for innovation, as well as detailed knowledge of- and access to relevant markets. Advantages primarily concern access to the resources and implicit knowledge of the large firm, as well as quick market access for the inbound case and low-risk commercialization for the outbound case.

Vrontis et al. (2017) examine the advantage to knowledge-intensive firms of organizational ambidexterity, i.e., being able to combine innovation with efficient operation. The study uses data from a questionnaire distributed to the CEO and CTO of selected firms. The researchers found no significant advantage to organizational ambidexterity for knowledge-intensive firms, which according to the paper is inconsistent with previous research under slightly different conditions. They did however identify a positive connection between knowledge-intensive firm performance and external knowledge sourcing.

West and Bogers (2017) survey the body of research on open innovation in order to identify a then-current status quo, as well as opportunities for future research. The study was conducted as a narrative literature review.

Wilden et al. (2017) conduct a systematic review of literature pertaining to service-dominant logic, a perspective in which all transactions are viewed as an exchange of services exclusively. They find amongst other things that service-dominant logic can be viewed as an interdisciplinary superset of- and antecedent to open innovation.

Zobel (2017) examines how enterprises can systematically realize their open innovation implementations into innovation outcomes as it pertains to creating competitive advantage. The study was conducted based on survey data. They found a positive connection between access to external technological resources and the ability to create competitive advantage through innovation. Furthermore, they found that this connection depends on the firms having the competence and capacity to utilize this access, as well as their absorptive capacity.

Bogers et al. (2018) discuss the (as of then) current state of OI in the context of research, business, and policy, and how it might fit in the picture of larger trends. The article is a literature review but has no findings that are relevant here.

Brunswick and Chesbrough (2018) conducted a survey to determine the degree to which large firms implement open innovation. The survey included 2445 large, defined as more than 1000 employees and 250 MUSD revenue, European and North American firms and concerned both successful and unsuccessful cases. The results showed a 78% firm-level adoption rate of open innovation, where 50% of firms adopted open innovation as a strategy more than five years ago.

Chesbrough et al. (2018) examine the creation and capture of value in sustained open innovation activities and seek to clarify the meaning of value in the context of open innovation. Four processes concerning value are identified and defined: Realization, provisioning, negotiation, and partaking.

Ghezzi et al. (2018) seek to organize the existing body of research on crowdsourcing from a management perspective. The study is a systematic literature review based on 121 articles from 2006 to 2015 and results in a description of how the field has evolved over time in tandem with related research on open innovation and co-creation.

Lee et al. (2018) try to determine appropriate areas for research, regarding responses to the fourth industrial revolution, in terms of institutions, technology innovation, and start-ups. The study was performed as a literature review. In response to industry 4.0, the researchers found that cooperation between start-ups and established firms can be key to competitive advantage. Moreover, the usage of external knowledge is a key requirement to stay competitive.

Lifshitz-Assaf (2018) examines how effective implementation of open innovation at NASA affected the existing culture and knowledge workers, who traditionally work in a manner incompatible with openness. The study was a longitudinal case study, using data from observations, interviews, and documentation, and collecting data over a period of three years. The researchers found that only the knowledge workers able to reassess their professional identity were able to effectively share and integrate knowledge across organizational borders. I.e., to extract value from a shift towards openness, the knowledge workers of a firm must be able to effectively adapt their identity to utilize afforded opportunities.

Nambisan et al. (2018) examine the practice of open innovation in relation to digital platforms. The paper is an essay, akin to a narrative literature review. The author concludes that while digital platforms have provided great and many entrepreneurial opportunities to businessmen and innovators, there is still great potential in the potential digital transformation, and the accompanying potential for openness, of innovation processes.

Santoro et al. (2018) attempt to understand how open innovation is implemented in SMEs specifically, and where they preferentially source knowledge. The study is conducted based on a questionnaire distributed to SMEs in and around Piedmont with 93 respondents.

The researchers found that the SMEs in question did not implement open innovation as defined by Henry William Chesbrough (2003), and for innovation purposes generally preferred internally sourced knowledge over external. Nevertheless, for sourcing of external knowledge, the SMEs were found to prefer market sources, e.g., customers, over public institutions, e.g., universities.

Watson et al. (2018) examine the relationship between open innovation and dynamic capabilities in the context of environmental innovation. The authors did a systematic literature review, followed by proposing a synthesized model for leveraging differences between stakeholders in an environmental innovation ecosystem, both on the resource level and with regards to their innovative approach.

Yun et al. (2018) use an open innovation-based model of the economy to attempt an analysis of the relationship between general economic growth and the trichotomy of market activities concerning open, private, and social innovation. The study uses publicly available macroeconomic data to develop a mathematical model to determine how imbalances between the three activity classes affect economic activity in general. The researchers find that balance between the activities is connected to strong and sustained economic growth, while dominant activity classes lead to economic stagnation or shrinkage.

Özdemir and Hekim (2018) propose an alternative to industry 4.0, in industry 5.0, that emphasizes the democratization of social- and power structures that emerges because of the technologies being employed, including challenges such as data- and infrastructure ownership. The proposal views industry 4.0. through the lens of innovation ecosystems and proposes means to align the incentives of different stakeholders.

Bogers et al. (2019) seek to reconcile emerging concepts from open innovation with existing concepts from strategic management theory. This is done by developing a dynamic capabilities framework, i.e., viewing open innovation to potentially alter the characteristics of a firm's resource base.

Jimenez-Jimenez et al. (2019) examine the indirect effect of information technology on product innovation, through its influence on supply chain collaboration. The study is conducted using structural equation modeling and based on data from 200 manufacturing firms. The researchers found information technology to boost both disruptive and incremental innovation through its effects on supply chain collaboration.

Santoro et al. (2019) assess challenges and success factors for SMEs in the implementation of outbound open innovation. The researchers conducted a case study, using data from eight Italian

technology SMEs. They found that differences in implementations of open innovation led to trade-offs with different characteristics in terms of challenges and advantages. I.e., while open innovation can be a valuable tool for SMEs, any firm wishing to implement it must be diligent about the extent, and how it interfaces with existing processes.

Secundo et al. (2019) explore the role of inter-organizational knowledge transfer in open innovation for the healthcare sector. The study is conducted as a literature review and produces a framework for facilitating inter-organizational knowledge flow, taking incentive differentials between different classes of participants into account.

Smith et al. (2019) examine barriers in innovation collaboration between private and public actors. The study was conducted as a case study of the development of mobility as a service in West Sweden and is based on interviews. The study found that different barriers were perceived, and barriers were perceived differently, between private and public actors respectively.

Zheng et al. (2019) propose the SCOAP (smart, connected open architecture product) paradigm for collaborative product development to exploit the potential for user involvement in the development of smart, i.e., connected, products. The proposal is based on a narrative literature review.

Dabić et al. (2020) conducted a systematic literature review, analyzing 762 articles from 1992 to 2018, with the goal of understanding existing research on internationalizing SMEs, international entrepreneurs, and the incentives afforded them in the face of progressively fewer barriers to compete in international markets. Their main finding is that strategic measures exist for SMEs to improve their capacity for successfully entering international markets, but also that scientific research on the area is partially lacking and unstructured.

Hausberg and Korreck (2020) conducted a systematic literature review on the topic of business incubators and accelerators. Their main finding is that business incubation can be understood through the lens of either open innovation, social capital theory, or resource-based frameworks. Furthermore, they found that the practice of accelerators and incubators has become more frequent in private corporations in later years.

Konietzko et al. (2020) propose a tool called The Circularity Deck to help firms with circularity potential in their innovation ecosystem, i.e., help them innovate with a bias towards circular economy outcomes. The study is based on a narrative literature review and a case study.

Papa et al. (2020) examines the connection between knowledge acquisition and innovation performance, and their relation to human resource management. The study is based on a questionnaire that was answered by 129 firms across multiple industries. The researchers found that

innovation performance is improved by knowledge acquisition, and that human resource parameters moderates the effect through parameters such as retention.

Sun et al. (2020) examines the effect of open innovation and knowledge management capacity upon dual innovation, i.e., organizational ambidexterity, performance. The study was conducted based on a questionnaire with 351 respondents. The researchers found that both open innovation and knowledge management capacity positively facilitates organizational ambidexterity. Inbound open innovation has the biggest impact on incremental innovation and outbound open innovation has the biggest impact on disruptive open innovation.

Trabucchi and Buganza (2020) analyze the relationship between digital platforms and innovation processes. The researchers first propose a conceptual model based on a literature review before data regarding 100 app companies is studied. The main finding is that it is indeed possible to capture value that exists in innovation ecosystems on top of digital platforms.

J. H. J. Yun et al. (2020) examine the car-sharing industry through the lens of open innovation, and if different implementations of open innovation can directly affect the business model. The study was conducted as a case study, concerning three large car-sharing firms, using interviews and a questionnaire. They found that car-sharing business models were shaped in contact with customers, regulation, and existing transport industries through a process that can indeed be understood as an implementation of open innovation. This process not only affected the business model itself, but also how it changes over time.

J. J. Yun et al. (2020) conducted a case study of the e-commerce firm Alibaba to determine the role of open innovation in the firm's growth. The study was conducted as an interview-based case study. They find, amongst other things, that cultural acceptance of open innovation was critical for the firm's success, despite the complexity introduced by open innovation organizationally and in business processes.

Fischer et al. (2021) analyze knowledge management practices for frugal innovation in emerging economies. The study was conducted as a case study, with interviews of 14 people at the University of Campinas in Brazil. They find that universities possess characteristics that are advantageous to frugal innovation in private enterprises, such that an innovation collaboration with universities benefits frugal innovation in emerging economies.

Oskam et al. (2021) seek to identify strategies to reconcile incentives of different stakeholders in innovation ecosystems, to facilitate sustainable business models based on collaborative innovation. The study is a case study, based on four cases of sustainable innovation collaboration. They found that for an innovation collaboration to be successful, the involved parties must find mutually valuable ecosystem configurations. Furthermore, two processes to achieve this were identified: First, the innovation ecosystem parties can agree on the purpose of their ecosystem upfront, and

have the ecosystem evolve according to the decided upon purpose. Secondly, they can iteratively explore ways to create and capture value, causing more frequent and bigger shifts in the innovation ecosystem value proposition over time.

Prasetyo et al. (2021) examine what factors relate to customer satisfaction for food delivery services during the Covid-19 pandemic. The study was conducted based on a questionnaire with 253 respondents. There were no findings within the scope of this literature review.

Sturgeon (2021) examine the strategic options afforded firms by virtue of digital transformation in the context of entering emerging economies. The paper is a literature review. To that end, they identify modularity, open innovation, and digital platforms as key factors for developing a successful business model.

## 8 DISCUSSION

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This section will discuss the selected literature in the context of the research questions stated in the introduction. Generally, the articles do not provide direct answers to the research questions, but many provide partial answers, and some provides insight into classes of solutions to be ruled out.

Many of the findings were concerned with the relationship between open innovation and the field of knowledge management, however since the research questions by design are looking for answers regarding commercialization and related practices, even the relevant findings were for the most part only partially relevant.

### 8.1 HOW CAN DISRUPTIVE AND INBOUND OPEN INNOVATION PROJECTS BENEFIT START-UPS AND SMES IN DIFFERENT PHASES?

Usman and Vanhaverbeke (2017) identify the primary advantages for start-ups of engaging in inbound open innovation with larger and more established firms as being access to the resources and implicit knowledge of the large firm. Specifically, Usman and Vanhaverbeke (2017) emphasizes the following:

- Lower cost research and development
- Quick market entry
- Technological support from the larger company
- Logistical support from the larger company
- Leveraging the larger company's reputation

Research and development end up cheaper as the start-up gets access to existing IP from the larger company, which is additionally advantageous with regards to the financial risk attached to research and development activities. Furthermore, subsequent development of an innovation can be done in a manner that splits the resource commitment between the firms in an advantageous way. A more established firm usually has a wider and deeper network than a start-up, in addition to better knowledge of relevant markets and often an existing customer base. Being afforded access to some or all of this significantly lessens the friction connected to market entry. Being able to lease, buy or lend technical expertise and infrastructure also significantly lessens the resource commitment from the start-up's point of view. Lastly "crossing the chasm" as described by Moore (2014), might be significantly easier if the start-up is somewhat able to mitigate the issue of trust in majority markets (Moore, 2014) by leveraging the larger firms reputation.

Findings by Zobel (2017) and Lee et al. (2018) respectively reinforce the narrative that open innovation can indeed be useful for SMEs, albeit with the reservation that the smaller firm must have sufficient absorptive capacity to utilize the external resources.



Özdemir and Hekim (2018) identify digital platforms as potentially attractive arenas for multi-actor innovation, while Trabucchi and Buganza (2020) found that it is indeed possible for SMEs to capture value that exists in innovation ecosystems on top of digital platforms.

## 8.2 HOW IS LEAN STARTUP-METHODOLOGY APPLIED DURING DISRUPTIVE INNOVATION PROJECTS WITH MULTIPLE BUSINESS ECOSYSTEM PARTNERS?

None of the reviewed articles have any findings directly related to the Lean Start-up methodology, however some of them had findings regarding practices that are also part of the Lean Start-up paradigm. The reviewed literature does however hint at unrealized potential, which will be the topic for the remainder of this section.

Based on the findings of Usman and Vanhaverbeke (2017), it is definitely conceivable that an SME could act as an extension of the larger firm however, while employing the Lean Start-up-method in relative isolation. Scutto et al. (2017) found the subject SMEs to prefer informal inbound modes of open innovation. The SME could for instance tend to be more experimental as per “build, measure learn” (Ries, 2011) without risking the large firm’s reputation. In that vein, the findings of Lifshitz-Assaf (2018), where some knowledge workers at NASA, a large public organization, had troubles adjusting to an open innovation paradigm may hint at a case where using collaborative innovation to indirectly implement e.g. Lean Start-up could be beneficial to achieve organizational ambidexterity. Furthermore, J. J. Yun et al. (2020) found, as an inverse to the case with NASA, that cultural acceptance of open innovation was critical for Alibaba’s success, so if collaboration lets a firm achieve an effectively dualistic innovation culture it might very well turn out to be a competitive advantage.

Santoro et al. (2018) showed that the subject SMEs currently preferred market sourced knowledge over that of public institutions, which further reinforces the idea that there might be unrealized potential to be realized from public-private open collaboration. Another challenge to overcome, as identified by Smith et al. (2019) is how different barriers to collaborative innovation is perceived, and how the same barriers are perceived differently between private and public actors respectively.

Oskam et al. (2021) interestingly found that a viable way to turn an open innovation collaboration into a sustainable business model was to have the innovation ecosystem evolve iteratively by having each participant independently search for ways to create and capture value. This suggests a permanent configuration of SMEs aiming for disruptive innovations based on the property of a larger firm might in fact be sustainable.

## 9 LIMITATIONS

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The search strategy filters out a substantial volume of potentially relevant articles from the literature study. This is intentional to manage the volume of articles, but it can potentially introduce biases with respect to e.g., author popularity. Some articles may or may not have been intentionally or otherwise search-engine optimized for certain keywords, such as “open innovation”, to fit the theme of their publishing journals. This may have resulted in articles being included, that with no publishing incentives might not have. Due to the authors language capabilities, only English articles were examined, which in turn may have introduced a bias such that predominantly research based on data from European and North American firms were included. The result of a literature study will to some degree always be contingent upon the person conducting the review, especially upon assessing the weight and relevance of a paper or parts of it. Limiting the literature review to the ten most cited articles per year introduces the possibility of different articles being included as new articles are published.

Overall, these are all points contributing to uncertainty in the results rather than potential causes for large errors.

## 10 CONCLUSION

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After synthesizing the results from the literature review, little research exists on the impact of open innovation in the different phases of entering the market, however it is abundantly clear that there is value to be extracted for start-ups and SMEs from open innovation partnerships in many cases.

As to the application of Lean Startup-methodology during disruptive innovation projects with multiple business ecosystem partners there exists a fair amount of research hinting that it might very well be a viable improvement to the innovation practices of many larger institutions, however no current research on this topic was found. This is an area that warrants further research.

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