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The relational dynamics in the extended teams of academic spin-offs: a Norwegian case-study

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Abstract: This research investigates technology transfer offices executives' role in commercialising academic spin-off projects. The study does also include other actors in the process, including academic entrepreneurs, department leaders, the chief executive officers of the companies, and investors. This group of actors is given the name *the extended team*. These actors possess different roles, identities, and competencies and need to cope with inherent challenges, conflicts, and dilemmas in the process of performing third mission activities of the university. By taking a relational approach to commercialisation processes, this qualitative study contributes to the literature by showing how an extended team of various actors communicate and co-create in a dynamic process, displaying balancing roles and tensions. The research also demonstrates that actors gaining experience within the field in turn will initiate systems and build capabilities within their universities to support commercialisation activities including the development of academic spin-offs.

Keywords: academic entrepreneurs; academic spin-offs; ASO; building capabilities within universities; commercialisation of research; qualitative study; communication and learning; extended team of academic spin-offs; knowledge and technology transfer; relational dynamics; technology transfer executives; third mission activities.

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1 Introduction

Innovation, knowledge, and technology transfer from university research are important to realise the third mission of universities. Academic spin-offs (ASO) are considered as one of the important mediators to fulfil this mission (Grimaldi et al., 2011; Link et al., 2015; Hossinger et al., 2019). Many universities have setup technology transfer offices (TTO) to facilitate commercialisation of research and to help establish spin-offs. A stream of research literature has followed, focusing on the facilitation efforts of TTOs in the technology transfer process. Traditionally, research investigating technology transfer has focused on licensing and patenting activities, in addition to the competence and effectiveness of TTOs (Siegel and Wright, 2015; Holgersson and Aaboen, 2019; Cunningham et al., 2020). Less research has investigated the challenges, tensions, and the roles individual TTO executives (TE) adopt during the commercialising process of ASOs (Weckowska, 2015; O'Kane et al., 2020). Moreover, scarce research has investigated the interaction and co-creation of several important actors surrounding the spin-off in one study (Villani et al., 2017; Wright et al., 2007). In this paper, the aim is therefore to investigate and highlight TE's role in commercialising ASO projects. This investigation does also embrace other relevant actors in the process, such as academic entrepreneurs

(AE), department/institutional leaders (DL), the chief executive officers (CEO) of companies and investors. This group of actors is depicted as the *extended team* of ASOs. Some scholars suggest that because of the early stage of commercialisation projects, with high specificity, inherent uncertainty, and complexity, TTOs and relevant actors surrounding spin-off projects must engage in interactive learning processes to acquire the necessary knowledge needed to develop these projects (Rasmussen and Borch, 2010; Rasmussen, 2011). Actors in teams surrounding ASOs play different roles and possess complementary competencies, but their interaction, interdependency and inter-reliance may also create tension and conflicts (O’Kane, 2018; Sadek et al., 2015).

Research on TTOs (Wang, 2018; O’Kane et al., 2020) and entrepreneurial ecosystems (Feldman et al., 2019) also suggest that a close interaction among relevant actors can aid developing the ASOs. Commercialisation of such spin-offs requires specialised competence in many fields and TEs need to work closely with academic inventors and other relevant external partners to acquire the necessary capabilities. This because the TTO is unlikely to have expertise in all areas of the research and market domain (Weckowska, 2015). More, TTOs need to build legitimacy and balance commercial and academic priorities when dealing with multiple stakeholders, such as universities, industry, and investors. This is a complex task because logics may overlap and stakeholder expectations may diverge (O’Kane et al., 2020).

By taking an extended team approach, the aim is to investigate the inherent complexities and tensions and the balancing role of the different actors in the commercialisation process of ASOs. The argumentation for such an approach is that the perceptions and dilemmas of a variety of actors contributes to a comprehensive understanding of the challenges to commercialise ASOs. The research, therefore, respond to the call for adopting a more dynamic view to analyse the commercialisation of ASOs and the need to integrate the interplay between different levels and actors surrounding the spin-off (Hayter, 2016; Hossinger et al., 2019).

In this empirical research, a qualitative, approach is used to examine seven ASO projects related to life science from one TTO in Norway, Vestlandets Innovasjonsselskap AS (VIS), situated in the city of Bergen. The overall goal is to investigate the roles, interaction, and relations in the extended teams of ASOs. Two research questions have been formulated:

- RQ1 How are the roles, complementary competencies and learning among the extended team members affecting the commercialisation process?
- RQ2 How can the extended team contribute to building relations, competence, and capabilities during the commercialisation process of ASOs in the research organisation and the TTO?

The paper is structured as follows: Section 2 outlines the theory used for the analysis. Section 3 outlines the research context and methods for the study, while analysis and findings are presented in Section 4. Section 5 discusses the findings, including theoretical and practical implications. At the end, some limitations of the study are elaborated, in addition to suggestions of new areas for research.

2 Theory

In this section relevant theory for the study is presented. The role of the TTOs and other important actors related to the commercialisation process in ASOs, is highlighted.

2.1 *The third mission of universities*

Almost all universities do now have access to a TTO (Etzkowitz et al., 2000; Link et al., 2015). This development can be seen as part of a trend affecting universities during the last decades, namely the move towards the ‘entrepreneurial university’ (Etzkowitz, 2017; Sánchez-Barrioluengo et al., 2019). ‘Entrepreneurial university’ depicts a development where universities increasingly complement their traditional missions (research and teaching) by a third one, that is, economic and social development. Universities are further expected to contribute to regional development by taking a more active role in commercialising their knowledge through spin-offs, patents, and licensing (Grimaldi et al., 2011). The rise of technology transfer and universities’ engagement in innovation and commercialisation efforts has also attracted considerable attention in the academic literature (Perkmann et al., 2013, 2021; Link et al., 2015; Siegel and Wright, 2015; Holgersson and Aaboen, 2019). One stream of literature has analysed the antecedents and consequences of university patenting and licensing. However, despite the effort from the society and universities to commercialise research, the actual development has not been as rapid as expected and quite few universities are successful at commercialising inventions that they have patented (OECD, 2013, 2019).

An ‘ASO’ is defined as a new company established by the exploitation of a research idea or technology generated within a university or research organisation (Smilor et al., 1990; Nicolaou and Birley, 2003). ASOs are considered important to generate new and often radical innovations. However, these spin-off companies are likely to meet significant barriers when they enter the business world (Colombo and Piva, 2012). An important barrier is the lack of entrepreneurial capabilities, knowledge, and resources within the universities, especially at the department level (Rasmussen, 2011; Rasmussen et al., 2014), as well as the academic nature and risk aversion of the academic founders themselves, where commercialisation activities are considered in conflict with the academic culture (Perkmann et al., 2013; Hossinger et al., 2019). Further, TTOs and regional public venture funds have been shown to reinforce the academic nature of the ASOs, rather than help the spin-offs connect to relevant networks and industry (Hayter, 2016). However, another stream of literature has also stressed the entrepreneurial dimension of university technology transfer. These authors have studied intermediate organisations that have emerged to facilitate commercialisation, among them TTOs. They find that TTOs can play a critical role to promote entrepreneurship, but mostly if an entrepreneurial culture exists within the university (Sadek et al., 2015; Wang, 2018).

2.2 *TTOs – roles and relations*

The role of the TTO has traditionally been described as specialised and transaction oriented, with an overall focus on patenting and licensing (Siegel and Wright, 2015). The most common view is that TTOs engages in transaction-focused commercialisation practice following a linear innovation process, and commercialisation activities are performed sequentially (Siegel and Wright, 2015; Weckowska, 2015). The technology

transfer performance of universities is found to be positively related to the competence and expertise of the TEs (Hossinger et al., 2019). O’Kane (2018) argues that two actors are especially important for value creation and innovation based on research from the university, namely academic scientists and TEs. Although functionally separate, a high role of interdependencies exists between TEs and scientists, and many scientists consider TTOs to be an important source of delegation of commercialisation activities in change for the preservation of their academic role (Hayter, 2016). However, there are also tensions in this relationship, as academic scientists are, in line with the development of the entrepreneurial university, increasingly taking on commercial and entrepreneurial activities (Boehm and Hogan, 2014). Such practice may also result in an increased tendency for scientists to sidestep their TTO when commercialising (Clarysse et al., 2011; Wu et al., 2015; Link et al., 2015).

Recently, some scholars have suggested that because of the inherent uncertainty and complexity of early-stage ASO projects, TTOs and relevant actors must engage in interactive learning processes to acquire the necessary knowledge to develop these projects (Rasmussen and Borch, 2010; Sadek et al., 2015). Weckowska (2015) takes a relational approach to TTO practice and reveals that some TTOs engage in relations-focused commercialisation practice that involve complex relationship management during the commercialisation activities, enabling long-term learning and the co-creation of knowledge to support the spin-off. This relational approach acknowledges that the innovation process is not linear, but progress as an interactive process where university and industry collaborate to match research and market needs. Moving towards a more interactive and relations-focused role would change the traditional role and functions of the TTOs, as university scientists and others are taking a more active role on innovation and entrepreneurial tasks (Jain et al., 2009; Rasmussen and Borch, 2010; Zou et al., 2018).

To cope with these challenges O’Kane (2018) shows that TEs are developing a more diverse role by probing deeper into the university and adopting an intermediary role between the university and various funding organisations. This intermediate role entails that the TEs also must interact with actors outside the university sphere, such as investors and other actors important for the development of the commercialisation projects (Hossinger et al., 2019). O’Kane (2018) further shows that TEs and scientists are working together in a flexible community where they can disengage and reengage in input and output activities along the commercialisation process. However, for some TEs the emerging entrepreneurial university, with more commercial active scientists, can be interpreted as threatening to their task to commercialise university research (Philpott et al., 2011; O’Kane, 2018). The probing of TEs deeper into the university may also be experienced as a mix of roles, or even a threat by university managers and administrators. Weckowska (2015) investigated learning-in-practice in TTOs and found two approaches to commercialisation, namely transactions-focused practice, and relations-focused practice. Both practices seem to co-exist and co-evolve in some TTOs while other TTOs are predominantly transactions focused. The development of a relations-focused approach is reported to be difficult in TTOs which are dominantly transaction focused. Weckowska (2015) further suggests that more flexible TTOs who can apply the most suitable approach to commercialisation, may display superior performance in the exploitation of academic inventions compared to TTOs with dominant transactions-focused commercialisation practice.

Based on the presented theory, the aim of this study is to explore how knowledge and technology transfer occur in the commercialisation processes of ASOs. In particular, the balancing roles and tensions between the TEs and the AEs, defined as the *core team*, is investigated. More, the balancing roles, and tensions within the *extended team* of ASOs, namely TEs, AEs, DLs, investors, and CEOs is explored. Depicting the group as a *team*, the interactive working process where actors, although functionally separate, collaborate and co-create to commercialise the projects is illuminated, emphasising the high role of interdependencies existing between the team members.

3 Methodology and research context

The research adopts an embedded multiple case study design (Yin, 2018). In general, multiple case studies represent a richer theoretical framework and are more robust as researchers can compare findings across cases and ground studies in varied empirical evidence (ibid). A purposeful sampling approach is used (Harsh, 2011), where the logic of the sampling lies in selecting information-rich cases. Seven ASO projects related to medicine and life science were selected from one TTO in Norway, VIS in Bergen, the second largest city in Norway. While Bergen is known for well-developed business ecosystems and industrial clusters within sectors such as subsea, maritime industries, fisheries, and aquaculture. Industrial life science is almost absent in the region. Consequently, the selected ASO projects are loosely connected to established regional industries, and the lack of regional anchoring is assumed to affect the members of the extended teams of ASOs in their execution of the commercialisation processes. It is inferred that relevant competence, networks, resources, and infrastructures are deficient to back up the early phase projects, and it is further presumed to be particularly challenging to develop and establish companies grounded in life science research. The selection of cases is based on literal replication (Eisenhardt and Graebner, 2007; Yin 2018), to predict similarities.

All cases were long-term development projects, requiring 10–15 years to reach market. The cases have been active commercialisation projects in VIS for 6–15 years. Most of the cases are still in early phase, while some are in or near the market. The TEs at VIS have a portfolio of commercialisation projects which they follow from the early idea phase to a mature stage and exit. This contrasts with many other TTOs where TEs specialise and focus on one or a few phases of the commercialisation, process, e.g., protection of intellectual properties (IPs) or market validation. All the cases had reached the stage of an early ASO and all of them found themselves in technology and market validation processes.

VIS is a regional innovation company and is also organised as an external TTO in the region. This means it is not an internal TTO department within the university, as defined by Brescia et al. (2014). VIS is owned by the University of Bergen (UiB) and Bergen University Hospital (HB), complemented with four other minor owners within research and higher education in the region. VIS also provide incubation infrastructure. UiB has, together with HB, the second largest research base in medicine and life science in Norway. This research base is also reflected in the number of ideas within life science received by VIS. In the period 2012–2020 an average of 50% of incoming ideas were within medicine and life science, the majority from UiB and HB.

3.1 Data-collection and analysis

Semi-structured interviews were used to collect data. Data were collected in two rounds (spring 2019 and 2020/early 2021). The research includes interviews with TEs, AEs, DLs, CEOs, and investors. The investors interviewed functioned as key informants as they represent two early-stage venture capital funds in Norway comprising a high number of different types of projects and investors.

The research questions and the interview-guide were in the first round based on theory on ASOs, AEs and TTO literature, as the researchers initially aimed to emphasise the TEs and AEs and their role in the spin-offs. However, as the research evolved, new research themes emerged, and new actors were added as the research team gained increased insights in their involvement in the ASOs. Hence, an abductive process in research was followed (Dubois and Gadde, 2002), where the research process goes back and forth between the theoretical framework and the empirical investigation.

Table 1 Description of the five types of respondents interviewed

| <i>TTO executives (TE)</i> | <i>Academic entrepreneurs (AE)</i> | <i>Department leaders (DL)</i> | <i>Chief executive officers (CEO)</i> | <i>Investors</i> |
|---|---|--|---|--|
| <i>7 respondents</i> | <i>10 respondents</i> | <i>6 respondents</i> | <i>3 respondents</i> | <i>3 respondents</i> |
| TEs from VIS, both currently and/or formerly responsible for the commercialisation project/spin-offs in the study. Two of the respondents have been involved in more than one of the seven cases. | Researchers from UiB or HB responsible for the initial research idea leading to an academic spin off. All the AEs are still active in some way or another in the extended teams. Some of the AEs are also acting CEOs of the ASOs, however these have been interviewed as AE in this study. | Currently or formerly DLs and administrative leaders from UiB and HB involved in the project. These respondents were selected based on both their formal roles as leader of the department, but also based on their actual involvement in the cases. Four of the respondents have been involved in more than one of the seven cases. | This actor group consists of external recruited CEOs. | This group of actors consist of investors who have been following one or more of the seven cases closely over several years. These investors have either already invested or are willing to invest if the case(s) successfully meet certain milestones in the commercialisation process. |

In total, 29 interviews with 28 respondents were conducted. Nine of the respondents were involved in several ASOs, and therefore interviewed about more than one case (see Tables 1 and 3). Seven of the interviews were conducted as group interviews. The themes in interviews varied according to the type of respondent (see Table 2) and the interview guides were accordingly adapted. The TEs were interviewed twice with different purposes in the interviews (project-based and individually-based). Interviews lasted between 50–90 minutes and were digitally recorded and fully transcribed. Confidentiality and anonymity of cases and respondents have been ensured. Triangulation of information, described as the use of multiple methods or data sources in qualitative

research to develop a comprehensive understanding of phenomena (Patton, 1999), was achieved by reading media articles about the interviewees/projects, studying websites, and participating in ASOs seminars. Additionally, all three authors have varying degrees of insider knowledge of the TTO, which facilitated access to respondents and validated the research findings.

Table 2 Themes in the interviews with the various types of respondents

| <i>TTO executives (TE)</i> | <i>TTO executives (TE)</i> | <i>Academic entrepreneurs (AE)</i> |
|---|--|---|
| <i>First round – project-based</i> | <i>Second round – individual-based</i> | |
| Project idea and development, research, technology and market validation, funding, challenges and critical events. Academic team/researchers involved. Role of networks and learning and commercialisation strategies. | Individual learning and competence building, learning and development of commercialisation practices at TTO. Transfer and sharing of practice and learning with external actors. | Entrepreneurial experience, project idea and development, critical events, research, and AEs involvement, entrepreneurial and researcher identity, learning and networks, commercialisation strategies. |
| <i>Department leaders (DL)</i> | <i>Chief executive officers (CEO)</i> | <i>Investors</i> |
| Background and entrepreneurial experience, the origin of the project from the departmental side, critical events, collaboration with the AE and the TTOs, institutional innovation and commercialisation strategies, barriers, learning | Experience and background. Experience in dealing with the extended team. Commercialisation strategies and challenges to establish a company, market strategies. | Profile of the investment fund, criteria for investment sectors, markets, regions strategies for selecting investment cases, networks, cooperation with TTOs. Lead investor role, attracting co-founders. Experience with ASOs. |

Table 3 provides an overview of the different actors involved in the commercialisation process and indicate the connection to one or more of the seven spin-off cases, briefly described in Table 4.

Table 3 Respondents and their connection to the seven spin-off cases

| <i>Type of respondents</i> | <i>Spin off #</i> | <i>Respondents #</i> |
|-----------------------------|-------------------|----------------------|
| Academic entrepreneurs (AE) | 1 | AE1 |
| | 2 | AE2 |
| | 3 | AE3 |
| | 3 | AE4 |
| | 4 | AE5 |
| | 3 | AE6 |
| | 5 | AE7 |
| | 1 | AE8 |
| | 6 | AE9 |
| | 3 | AE10 |

Table 3 Respondents and their connection to the seven spin-off cases (continued)

| <i>Type of respondents</i> | <i>Spin off #</i> | <i>Respondents #</i> |
|-------------------------------------|-------------------|----------------------|
| Technology transfer executives (TE) | 3, 5, 7 | TE1 |
| | 2 | TE2 |
| | 4 | TE3 |
| | 6 | TE4 |
| | 2 | TE5 |
| | 1 | TE6 |
| | 3, 5, 7 | TE7 |
| Department leaders (DL) | 3, 6 | DL1 |
| | 3 | DL2 |
| | 2, 7 | DL3 |
| | 6 | DL4 |
| | 2, 7 | DL5 |
| | 4, 5 | DL6 |
| Chief executive officers (CEO) | 7 | CEO1 |
| | 2 | CEO2 |
| | 4 | CEO3 |
| Investor | 7 | Inv1 |
| | 4, 7 | Inv2 |
| | 2, 7 | Inv3 |

Table 4 A short description of the seven spin-off cases at the time of the study

| <i>Spin-off #</i> | <i>Description</i> |
|-------------------|---|
| 1 | An ASO within MedTech. The project was in the proof-of-concept phase and no product was on the market. Investors had shown interest in the case, but still no actual investment had been made and the development was supported by public soft funding. |
| 2 | An ASO within drug development. The product development was still in very early phase, but the company had several external investors and had also received public soft funding. |
| 3 | An ASO company producing novel biomaterials. The company had attracted public soft funding and an external investor. The development was still in the proof-of-concept phase and no product was on the market. |
| 4 | An ASO within MedTech producing a new diagnostic tool. The product was available on the market and the ASO had attracted several external investors. |
| 5 | An ASO within MedTech producing a novel treatment method. The product was in clinical trials and the ASO had attracted many, but small investors. |
| 6 | An ASO within MedTech developing a new method for producing medical drugs. The product was in the proof-of-concept phase and the spin-off had several interested customers, but problems attracting funding. |
| 7 | An ASO within drug development. The product was in clinical trial studies and the company had attracted several investors. |

Note: ASO = academic spin-off.

The data analysis was inspired by a phenomenological analysis approach (Smith et al., 1999), starting with:

- 1 reading the case
- 2 diagnosis of the case
- 3 developing intra-case themes
- 4 developing inter-case themes
- 5 writing up
- 6 enfolding literature.

The last step involves an iterative and comparative process of tacking back and forth between existing theory and the data. All authors read the material separately and developed initial themes. The authors then performed an analysis together to develop and discuss themes emerging in the material, enhancing inter-rater reliability and research validity. The following themes were developed during the first phase of data analysis:

- a complementary and conflicting roles
- b competence
- c relational dynamics and knowledge transfer/sharing
- d learning and communicative abilities
- e regulatory barriers.

The interviews were coded and analysed based on these five themes and a rich data corpus consisting of quotes in relation to these themes were produced for each group of actors. In the second phase of analysis the findings were grouped in the following three thematic sections, which also comprise the analytical and empirical findings in Section 4 below:

- 1 balancing complementary and conflicting roles
- 2 competence, learning and communicative abilities
- 3 relational dynamics in the extended teams.

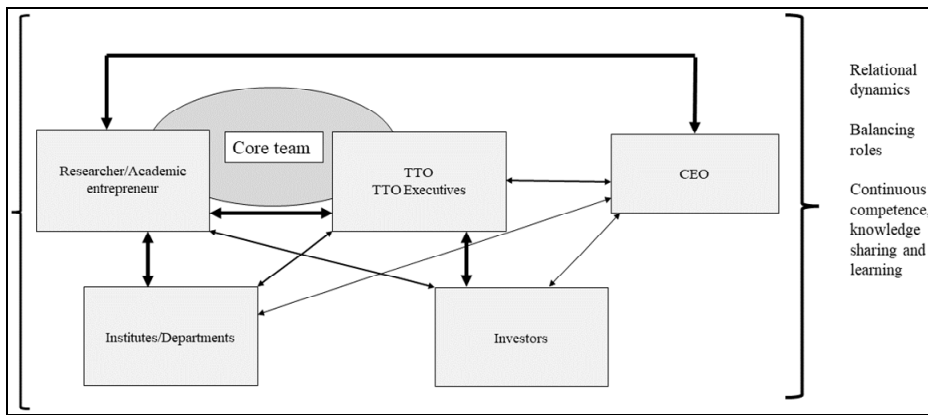
4 Analysis and empirical findings

Figure 1 visualises the relationship between different actors in the extended team of ASOs. In the figure, the *core team* is highlighted consisting of the AEs together with the TEs. The AE is the person or group of persons with the idea or technology, and which forms the point of departure for the commercialisation process. The TE is the person or persons responsible for the commercialisation projects on behalf of the TTO (VIS). Tight collaboration and a high role of interdependency exist between the AE and the TE, indicated with strong arrows. In initiating a commercialisation project, the AE discloses the invention to the TTO, and is connected to a TE. Normally, the TE follows the project through the process, and collaborates closely with the AE on issues such as securing

intellectual property rights (IPR), pursuing commercialisation strategies, obtaining proof of concept funding, and scouting for industrial partners.

The core team is complemented by various actors involved in the commercialisation process. This group is defined as the *extended team*, and consist of DLs where the AEs are affiliated, investors and the external CEO of the ASO. DLs, or the ones appointed by the DLs, are important in relation to questions about use of staff, resources, lab facilities and infrastructure. Investors may be linked to the projects in various phases but are often early in establishing contact. Investors further conceivably provide capital in exchange for equities, but may also act as more informal advisors on, e.g., IPR and capital strategies. External CEOs are often connected to the projects at later stage when more formal organisational structures are established around the spin-offs. They may represent a new take on the development process, and often have a commercial orientation and steer the projects more towards the market. Analysing the ASO cases, it is observed that the AEs have a tight and close dialogue with their DL. The TE communicates more closely with the investors. Where an external CEOs has been recruited, they seem to be collaborating most closely with the AEs. These relations are visualised in Figure 1.

Figure 1 The core team and the extended team of academic spin-offs – empirical findings



Notes: The thickness of the blue arrows indicates the frequency of contact between the members in the extended team. CEO = chief executive officers and TTO = technology transfer office.

4.1 *Balancing complementary and conflicting roles*

Although operating separately, a high level of interdependency between the members of the extended team is assumed. When analysing the complementary roles, a positive and clear division of labour among the team-members is expected, first among the TEs and the AEs, then among the other members of the extended team. This division of labour is agreed upon early in the relationship. All the respondents in this study demonstrated that they defined their roles and division of labour as rather clear. However, when conflicting roles occur, it was observed that roles were not so clearly defined, and sometimes overlapping causing an unclear division of labour.

All the respondents reported culturally-based conflicts well documented in the literature, such as patenting versus publishing and research versus commercialisation activities. These are conflicting situations where the AEs typically need to choose between the role as a researcher and the role as an entrepreneur. Such situations can create tensions and conflict. The AEs reported several incidents where they meant that the TE was trying to move the project away from a scientific direction or in a direction where the AEs could lose control of the project:

“It has been situations where VIS has done things differently from the way I saw as the best for the project, and they may have decided towards commercialisation at times where I meant that the science was more important.”

Based on the interviews it was observed that the TEs were taking on tasks considered outside the more typical TTO activities, this could typically be, e.g., writing research grants and continue working within the spin-off projects after a spin-off company was established and traditional TTO involvement normally would end. In this way the TEs are probing both deeper into the university sphere and down the commercial value chain by engaging in commercialisation activities to realising the spin-off as described by O’Kane (2018).

The observations also show that the TE in some of the cases was flexible when conflicts occurred. Respondents reported about situations where the ability to listen and change direction of the project was necessary, as illustrated by this quote from one of the TEs:

“We concluded that if this project shall succeed, VIS need to let go of our controlling position.”

DLs were generally supportive and wanted to facilitate the commercialisation process as much as they could within the regulatory and budgetary framework available to the department. The DLs seem to come in late in the commercialisation process, even later than the formal procedures between VIS and their partnering organisations should imply. Most of them did also express concern about having to take decisions without being adequately informed about the project or the consequences of their decisions. Some of them accepted this and were comfortable taking decisions although aware of the lack of information. Other mentioned that their role in the project as DLs and the departmental view was not respected, here illustrated by a quote from one of the DLs:

“I was left with a feeling that yes, they saw the problems and challenges for our department, but at the same time VIS did not acknowledge them.”

Several of the DLs also highlighted that commercialisation projects should be aligned with the scientific and professional strategy at the department:

“If the project had been professionally anchored in the department, the case would have been completely different.”

Although, the TE respondents seem to emphasise the departmental role and support for the commercialisation project, the analysis reveals that the TEs in general seem to lack a clear strategy for understanding and nurturing the relationship and role of the DL (or the one the DL appointed) to the extended team.

This conflict may be a result of a university lacking the operational characteristic of a fully developed entrepreneurial university as described by Etzkowitz (2011). However, it can also be the result of unclear and conflicting roles as the TEs are probing deeper into the university sphere as described by O’Kane (2018), such as assisting with grants and setting up agreements concerning working conditions for the AEs.

4.2 Competence, learning and communicative abilities

All team members were observed to lack some of the competence or absorptive capacity to be able to contribute completely to the commercialisation of the ASOs. ‘Absorptive capacity’ is here understood as the ability to identify the opportunities in science and technology, develop and apply them to business strategy and innovation (Cohen and Levinthal, 1990). In line with prior research (e.g., Rasmussen, 2011), the data show that it is difficult for one actor to possess detailed knowledge of all aspects of an ASO project. Hence, the extended team depended on the different competencies of the other team members and other relevant actors. Most of the respondents highlighted the importance of teamwork and the significance of how getting the right competence at the right time to the ASO, e.g., in terms of new hiring or from international expert consultants and contract research organisations. The difficulties of getting the right competence regionally were pointed out from most of the respondents. Also, the difficulty of short-term funding of commercialisation activities securing critical human resources was a significant barrier.

A high interdependency among the team members were observed, and especially the TE and AE were connected in a close relationship around the spin-off projects. AE, as researchers, seem to possess the most important expert and power base (Stahelski et al., 1989), in line with the findings from O’Kane (2018). Throughout the interviews the AE seemed most focused on their research using the spin-off process as a way of getting this research out to the society. They acknowledged the other team members but were in general equally focused on other collaborating partners, academic or non-academic, outside the extended team. The TE, the investors and the DLs were more focused on how to support the AE in the commercialisation process. Differences in focus and competences did in some cases lead to a knowledge asymmetry in the extended team and hence produced a power asymmetry where members used their power base to obtain resources and goals. This happened especially in the relationship between the AE and TE, but we did also see examples where the DLs were using their formal power to customise the spin-off project into the university sphere, despite their actions were slowing down the commercial process. This is illustrated by a quote from one of the DL:

“I wanted to make sure that the department was a part of that process and avoiding a situation where nothing was left for us.”

Most respondents reported extensive learning in working with the spin-offs, triggered both by the uniqueness and complexity in the projects, and the interactive learning and communication with members in the extended team and others. All the extended team members needed in one way or another to ‘sell in’ the project to different stakeholders. The AE explained that they learned a lot working with industry and along the regulatory pathway for their technology. This learning process made them work differently and in a more structured way than before also in their ordinary research projects. The AEs were in

general emphasising that the interaction with the TTO, the investors, industry, and customers made them think differently about their research:

“When you are in forums with industry and investors you have people with multiple backgrounds. Then you must adapt to them and it’s amazing to realise that people understand what you’re doing.”

The TEs did also report extensive learning, but their learning was more associated to the commercialisation process in general, and especially issues connected to business and investing strategies including market identification and exploitation of opportunities. More, the TEs learned progressively how to prioritise the projects when they had too many of them, and to understand customer needs balanced with the need for technological verification. Furthermore, they learned how to handle the balancing of long-term funding for the projects with more short term go-no go milestones, etc. Although the learning in each of the cases must be considered as unique, many of the TE reported that they had learned much from their own experience and failures, but also by the collaboration with others. The TE especially highlighted the learning from working close with investors and CEOs:

“There was a lot of learning-by-doing. I was collaborating with others with more experience, and I also failed many times. You learn a lot from the mistakes you make.”

For most of the DLs, the ASOs in this study were their first commercialisation project. Their learning aspects were therefore principally connected to commercialisation of research and about the activities and the role of the TTO. They described a significant learning curve and many of them had adapted this learning into better practices within their departments, here illustrated with a quote from one of the DLs.

“I realise that we now are much better in handling the other commercialisation projects at the department. We have a clearer strategy, and we are much more ‘hands on’.”

Some of them even stated that they used the project as examples when they were promoting the department in different contexts. The value of giving something ‘back to society’ was also highlighted by the DLs.

But the DLs did also conveyed a general lack of information and communication, where they were urged to make quick decisions without sufficient knowledge about the project and commercialisation process:

“I think there has at all the time been a poor communication with VIS, both in terms of status of the project and following up. As a department we must be considered as co-owner in the project.”

The investors interviewed represented the pre-seed phase, meaning their investments are in the early and risky phase of the ASOs. They were therefore particularly concerned about how to get the AE to communicate and ‘sell’ their spin-offs to seed and venture capitalists and other co-investors. All the investors reported a high degree of learning and interpersonal trust, especially about how to learn the rules of the game within the life science industry. Moreover, they acknowledged that life science is an emerging industry in Norway where investors typically have little knowledge and demonstrate hesitancy to make investments. Also, learning, and increased understanding for the need of long-term investments within life science compared to other industries were highlighted, as illustrated by this quote:

“One must think of a generalist investor as a teenager, and then be able to translate the message into the language this kid masters. For many generalist investors, life science is very distant. In other words, everything within basic biology, biotechnology, and chemistry for that matter, is terribly difficult for generalists to understand.”

4.3 Relational dynamics in the extended teams

The continuous interaction and co-creation of knowledge in the extended team materialised as a relational dynamic throughout the commercialisation process of the spin-offs (illustrated in Figure 1). The relational dynamics seemed connected to both the understanding of roles, and the need for communication skills and complementary competence. The TEs were seeing themselves as the key enabler within the team. They further looked at themselves as the ones mainly responsible for moving the project towards commercialisation, either by pushing on the AEs, complementing the team with external resources, or getting external funding for the activities needed. Many of them used time and energy to understand and building the relations within the team, here illustrated by a quote from one of the TEs:

“It’s a lot about relationship building and it must be considered a part of the job. It is important to get in touch with the right people, and to have a good dialogue with the researchers – but it is not always easy. There are a lot of different researchers who... yes... they all require different approaches.”

Another important observation is the close collaboration between the TE, the investors, and the AEs. The investors were involved in the project at very early stages, long before they made investments. The investors were in contact with both the TE and the AE, both separately and in joint meetings. Co-investors in the individual cases were also collaborating, relying on each other to ensure they were making the right investment. The AEs were particularly concerned about the support from the DLs, both in terms of getting access to the necessary research infrastructure for the spin-off, but also in terms of strategic support:

“The phase 1 clinical trial has been dependent on goodwill both from the various research teams, and all the way to the top in the institutional management. It has been very, very important!”

All the respondents explained how they used their existing network to get the right competence and resources to move the project in the right direction. Together this makes up a quite large network and competence base within health and life science in Bergen. Especially the CEOs did express the need to pool this competence to prevent new commercialisation projects and spin-offs to start all the way from scratch:

“We have too few people or companies in the region who have this type of competence (health, regulatory). My vision is to be able to build up a parent company that has this type of expertise and share it with other in the business.”

A summary of our most important findings can be found in Table 5.

Table 5 Summary of the main findings from the study

| <i>Thematic sections</i> | <i>Findings</i> |
|--|---|
| Balancing complementary and conflicting roles | <p>AEs possessed the most important expert and power base.</p> <p>TEs needed to balance their role to develop and maintain well-functioning relationships with the AEs.</p> |
| Competence, learning and communicative abilities | <p>ASO development depend on a wider set of actors with complementary skill capabilities, like DL and CEOs.</p> <p>The extended team as <i>a collective</i> could provide the necessary industrial, managerial, and entrepreneurial experience in the early phase of the ASO.</p> <p>Departments gaining experience in commercialisation can start to initiate systems to support the development of ASOs.</p> |
| Relational dynamics in the extended teams | <p>TEs had adopted a relations-focused commercialisation practice in the ASO development, and this focus was necessary to accomplish commercialisation processes of ASOs.</p> <p>When adopting a relations-focused commercialisation practice, the TEs risk entering more conflicting roles, especially when AEs adopted to a more entrepreneurial identity.</p> <p>The innovation process is not linear with respect to commercialisation of research, but progress as an interactive process where universities, industry and other actors collaborate back and forth to match research and market needs.</p> |

Notes: AE = academic entrepreneur, ASO = academic spin-off, CEO = chief executive officers, DL = department leaders, and TE = technology transfer executives.

5 Discussion and theoretical implications

The findings from this research have implications for both scholars and practitioners such as university managers and TTO leaders. In the sections that follow we expand on the most significant of these.

5.1 *Interactive nonlinear innovation processes and relational dynamics*

This study reveals that the TEs had adopted a relations-focused commercialisation practice in ASO development. The study further shows that an interactive and relations-focused practice was necessary to accomplish the complex task of ASO development. This development is characterised by a relational dynamic that involved on-going learning processes, interactive co-creation of knowledge processes and intensive communication and knowledge transfer to collectively develop and establish ASOs. The finding supports Weckowska (2015) and O’Kane (2018), acknowledging that the innovation process is not linear with respect to commercialisation of research, but progress as an interactive process where universities, industry and other actors collaborate back and forth to match research and market needs.

The study also supports scholars’ suggestions that ASO development depend on a wider set of actors, including the university departments, CEOs, and investors. In addition, the individual experience and motivations among AEs has proven to be very important (Perkmann et al., 2013, 2021). Instead of emphasising deficient human and

social capital among AEs (Hossinger et al., 2019), this study suggests that the extended team as *a collective* could provide the necessary industrial, managerial, and entrepreneurial experience to the spin-off. More, and in accord with Bock et al. (2018), it is also found that investors' engagement in the extended teams, and their role in coaching the AE can help overcome the problems of uncertainty and asymmetric information in the fundraising process and as such enhancing the credibility of the spin-offs to acquire key resources. The study therefore supports previous research (Hossinger et al., 2019) that highlight the need for heterogeneous knowledge in the management teams of ASOs.

The study also adds to existing research with the extended team perspective, emphasising how separate, but interdependent actors can function as a dynamic heterogeneous team in the early phases of life science spin-offs to improve ASO performance. Most studies have emphasised only a few actors, such as TTOs and AEs. The results from this study demonstrate how a larger team of actors communicate and co-create in a dynamic process, displaying balancing roles and tensions. Further, the research supports earlier studies suggesting that the venturing process of ASOs, not least in life science, is highly complex, long-term, and dynamic and would depend on co-creation of knowledge and access to specialised networks and expertise among many actors (Rasmussen, 2011).

5.2 Learning, co-creation of knowledge, competencies, and power

The mutual learning and co-creation of knowledge in the extended teams was essential because TEs would not alone possess the necessary knowledge to commercialise the research projects, and as such needed to engage in deep learning processes with others. Because of the early phase of ASOs, the long and complex development paths, and their uniqueness, all actors lacked absorptive capacity to fully comprehend and manage the development process. An entrepreneurial and co-creational approach was therefore needed, and all the actors contributed with knowledge and competencies, networks and ideas that collectively contributed to commercialisation. Yet, the high interdependency with respect to competencies and knowledge could also produce knowledge and power asymmetry where actors could exploit their power base to obtain their own goals.

This research suggests that AEs possessed the most important expert and power base, in the extended team, meaning that the spin offs depended highly on the AEs because of their research knowledge and their position to demonstrate legitimacy in relation to investors and industry. In consequence, TEs needed to balance their role to develop and maintain well-functioning relationships with the AEs. The DLs described a general lack of information and involvement in the spin-offs and could use their formal power even though this could slow down the commercialisation process. These findings echo existing research, emphasising how important the relationship with parent organisations is, especially at the department level, for the development of the ASOs (Rasmussen et al., 2014). This study thus adds to existing research by showing the importance of the involvement and support of the parent organisation. More, the lack of absorptive capacity related to commercialisation, markets and industry has been shown to sometimes lead to failure in realising the risks and resources needed to succeed and is therefore another reason for adding the DLs in the extended team. The research shows how an extended team approach can contribute to building relations, competence, and capabilities during the commercialisation process of ASOs. Finally, the research also demonstrates that

departments gaining experience in commercialisation of ASOs in turn will start to initiate systems to support the development of spin-offs. Departments actively engaged in commercialisation activities can as such be important contributors to create a culture and build capabilities for innovation, commercialisation, and entrepreneurship at the university. In turn this can help to gradually reduce the complexity often associated with implementation and execution of commercialisation activities at universities.

5.3 Relations-focused commercialisation practice and risk of conflict

When adopting a relations-focused commercialisation practice, the TEs risked entering more conflicting roles. This is because the relations-focused approach created fewer clear lines with respect to division of labour (complementary roles), and the responsibility to decide who was going to be involved in the commercialisation tasks. This could relate to the identification and choice of market segments, the overall business strategy, and relations to investors. For instance, TEs and AEs could engage in overlapping roles and as such 'rival' about commercialisation tasks and decisions, potentially producing conflicts. The balancing and conflicting role became especially evident when AEs adopted to an entrepreneurial identity (Zou et al., 2018), rather than a researcher identity. Also, when the TEs probed deeper into the university sphere as described by O'Kane (2018) tensions and conflicts were observed, especially with the DLs. It was also found that the relations-focused practice of TEs could sometimes reinforce a passion and feeling of ownership towards the ASOs obstructing a more balanced role. The findings are as such in line with Klerkx and Leeuwis (2009), who shows that when intermediary structures change their identity and tasks it can cause confusion among stakeholders about their actual value.

The research has also practical implications for stakeholders like governmental entities, universities and TTO leaders. The findings show how a relations-oriented practice may be beneficial over a more traditional transaction focused practice especially in the early phase of ASOs' commercialisation process. The study also demonstrates the importance of including the parent organisation of the spin-offs, especially at the department level, in the extended team of ASOs. Further, the empirical findings demonstrate how interactive learning and gaining experience in turn can build competence and capabilities for innovation and commercialisation at the department level.

5.4 Limitations and future research

The research is carried out in one region in Norway and includes seven ASOs within life science in one TTO. There are therefore limitations with respect to the generalisability and external validity of the research findings. The Norwegian context and the specific entrepreneurial ecosystem for life science projects could be one limitation. Other regions with stronger life science industries could deploy other commercialisation practices and other needs for the ecosystem to co-create and interact. The specific TTO demonstrated a special relations-focused commercialisation practice which could have influenced the relational dynamics found in this study, e.g., that socially anchored personal relationships in an ecosystem may be required to produce the revealed relational dynamics. Hence, the research findings from this study might be contextually bound to the regional entrepreneurial ecosystem.

Future research should explore commercialisation practices in other TTOs, regions and countries to investigate other organisational and geographical contexts. Likewise, ASOs targeting other industries should be examined. Longitudinal research design (Menard, 2002) following extended teams of ASOs over time (5–10 years) is challenging but could provide valid research findings about the actual processes and tensions, as retrospective accounts will suffer from memory bias. Finally, a parametric study could be a valuable contribution and validation of the main findings from this study.

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