

## How entrepreneurial motivation affects teamwork in Academic spin-offs

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**ABSTRACT**

Academic spin-off (ASO) is expected to play an important role in innovation. In our study, we investigated how team-building in ASOs is done before and after the establishment, where academic and non-academics professionals coexist. We conducted nine interviews in Tohoku University, and found that different types of entrepreneurial motivations influence the composition of the founding team and the subsequent teamwork. We present a theoretical model to explain this causal relationships. Findings from our multiple case studies highlight the importance of dynamic perspective to understand human resource management in ASOs.

**Key word:** ASO, Entrepreneurial motivation, Team formation, Teamwork

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## 1. INTRODUCTION

Innovation means not only drastic new findings in science and technology, but also such a development that can bring impact to the economy and society. As innovation is indispensable for sustainable economic development (Kuznets, 1930), newly born technologies have to be properly managed to create value to the society. In general, Innovation is driven by three domains: government, industry and university (Henry Etzkowitz, 2003). In these three organizations, fundamental research in universities has been recognized as one of the most important factors for promoting innovations (Mansfield, 1991).

How universities drive innovations include various activities such as joint research, licensing and establishing an academic spin-off (ASO hereinafter,). ASOs can be defined as firms established in order to commercialize academic knowledge and technology and the research outputs that accumulated in a university (Pirnay, B Surlemont, 2003). It is reported that ASOs perform better than average ventures in terms of the survival rate, raising funds and IPO (Blair & Hitchens, 1998; Goldfarb B & Henrekson H, 2003; Muster, 1997). In addition, universities can create more profit from ASOs than conventional licensing to other companies (Matkin,1990). Thus, establishing ASOs is an important way to commercialize scientific innovations (Djokovic and Souitaris, 2008; Shane, 2004), and its role in accelerating technology innovation and

promoting economic development is increasingly recognized. (Berbegal-Mirabent et al., 2015; Block et al, 2017; Guerrero et al, 2015).

Along with its important roles in innovation and society, ASOs have gathered academic attention from researchers. The venturing process of an ASO is complex, long-term and dynamic, involving factors from multiple dimensions (Rasmussen, 2011; Miranda et al, 2017). Specifically, there have been many researches about ASOs' characteristics, in which the main focus is on patent, intellectual property right and fund(Inamura, 2008; Yamada, 2015). This is reasonable considering that ASOs originated in "scientific findings" so that their basic issues are mostly technology transfer and financing.

However, the research lacks a perspective on "human resource management". As ASOs are born out of university labs, they often do not have adequate know-hows for business (van Greenhuizen and Soetanto, 2009). Therefore, it is challenging for academic specialists to solve various unexpected issues in the process of business development, so they need input from the side of industry. Moreover, it is implicitly required that researchers from the academic side intensively work on early business because a team in ASOs is usually dependent on the researchers in utilizing the core technology (Shimizu, 2014). As ASOs hold human resources from the both side of academics and industry like this, there often rises information asymmetry of technology and business between them (Tsuji moto, 2008). A team in ASOs has to solve this gap and stay together

to succeed in their business. In particular, the motivations of researchers in academia come from a desire to contribute toward science development, which is totally different from motivations for personal economic profit (Merton, 1973). Such environment of ASOs often lead opposed opinions and purposes, serious conflicts and incomplete corporate governance, which is recognized as the barriers for ASOs' growth (Davey et al. 2016; Neves and Franco, 2016; Vohora et al., 2008).

In addition, while many researchers focus on individual factors such as the roles, motivations, and characteristics of the researchers (Matsuoka & Yamada, 2010; McQueen & Wallmark, 1982; Shane, 2003), the whole processes of team-building is hardly considered in the previous researches (Inamura, 2008; Clarysee & Moray, 2004; Yamada, 2015). Although innovation is generated in social networks where specialists in different fields cooperate with each other, how individuals with different specialties, background and experience of academia and industry cooperate for ASOs' growth is still a black box.

Therefore, our study aims to reveal the team-building process in an early stage of ASOs' establishment. To achieve this goal, we conducted in-depth interviews in two venture capitals and five ASOs in Tohoku university, focusing on key persons who took part in the establishment of their own ASOs. ASOs of Tohoku university provides an excellent context to our study, as it is one of the representative research-oriented universities in Japan and we, as students of this university, have relatively high

accessibility to them, which enables us to collect rich original data on our topic. Our findings suggest a theoretical model explaining how entrepreneurial motivations affect composition of human resources in ASOs, which subsequently influence the degree of cooperation and business growth in the organizations. By providing a rare in-depth case study of ASOs in Japan context (Fisch et al., 2016; Yamada, 2015), our research extends the findings of existing studies. Specifically, our findings underline the importance of human resource management issues in ASOs and provide rationales to understand what issues are created and why.

## **2. LITERATURE REVIEW**

### **2-1. Innovation Management and the role of Universities**

We can define innovation in the economic system as “innovation which brings about economic impact” (Schumpeter, 1934). We need to manage technologies properly to create innovation, because innovation is driven and accepted by humans, who are social beings, so innovation is social activity and has to be grasped from the viewpoint of humans.

Innovation is mainly carried out by three organizations, university, industry and government (Etzkowitz, 2003). Specifically, universities have three important functions; training and human resources, creating “seeds” for innovation, accumulating high-

quality knowledge (Hitotsubashi University Research Institute for Innovation; 2001). In order to implement seeds created in universities into the society, universities conduct joint research, make contracts of licensing or establish academic spin-offs (ASOs). ASOs are highly expected to make “seeds” into innovative products as the bearer of innovation (METI, 2020).

## **2-2. Academic Spin-offs (ASO)**

Building on previous researches, we define an ASO as a new firm created to commercially exploit some knowledge, technology, or research results within a university (Pirnay, B Surlemont, 2003). Shane (2004) pointed out that there are five reasons why ASOs are important; promoting the development of regional economy, implementing technology within university into society, accomplishing the mission of university, such as education and research, giving more financial benefit than licence contract with companies. Recently, ASOs are becoming more important in Japan because they are considered to play an important role in developing our country by creating innovation (Mizuho Research Institute, 2016).

There are a lot of studies on the characteristics of ASOs. ASO's venturing process is complex, long-term and dynamic, involving influencing factors from multiple dimensions (Rasmussen, 2011). We summarized existing studies on ASOs venturing process by factors at three different levels; micro-level, meso-level, macro-level (Stefan Marc



Hossinger et al., 2019).

In the research about factor at macro-level, a lot of studies focus on regional and national context, level of economic development and support from venture capitals(VCs).Countries and regions with superior market and financial situations are considered to have more successful opportunities for ASOs (Davey et al., 2016: Neves and Franco, 2016). Knockaert et al. (2010) indicated that financial support from VCs helps ASOs to grow a business in early stages. Support from VCs involves providing management skills and connection with other resource providers (Hayter, 2013: Ortín-Ángel and Vendrell-Herrero, 2010).

In the research at meso-level, the main theme is the role of university. Rasmussen and Borch (2010) pointed out that sustainable ASOs development depends on a university's capabilities. Universities with excellent scientific productivity and innovation capability demonstrate superior entrepreneurial performance (Bonaccorsi et al., 2014: Jung and Kim, 2017: Rasmussen and Borch, 2010: Van Looy et al., 2011).

Most research at micro-level focuses on company or individuals, such as strategy and purpose of ASOs, team building and individual's motivation for ASOs. The main theme in micro-level is composition and characteristics of founding members. The composition and characteristics of the founding team also play a critical role in determining ASO performance (Ben-Hafaïedh, Micozzi and Pattitoni, 2018 : Borges and Filion, 2013 : Criaco et al., 2014 : Ciuchta et al., 2016 : D'Este et al., 2012 : De Cleyn et al., 2015 :

Fernández-Pérez et al., 2015 : Ferretti et al., 2018 : Gimmon and Levie, 2010 : Helm et al., 2016 : Huynh, 2016 : Huynh et al., 2017 : Knockaert et al., 2011 : Nielsen, 2015 : Roberts , 1991 : Toole and Czarnitzki, 2009 : Visintin and Pittino, 2014 : Wennberg et al., 2011). Many ASOs answered that team-building is essential for the growth of ASOs (MITI, 2020).

### **2-3. Team Building in ASOs**

The uniqueness of ASOs' team building lies in members with diverse backgrounds: academic and non-academics. First, Academics engage in ASOs as specialists in science and technology. Most ASOs have to keep doing R&D in early stages because their technologies haven't been developed enough (Nelsen, 1991). Most part of knowledge which is used for R&D is tacit knowledge. So, it needs cooperation by inventors to precede R&D. Academics' motivation for establishing ASOs is different from personal financial gain (Merton, 1973). McQueen & Wallmark (1982) pointed out that most scientists are engaging in ASO not for financial purpose, but more for further developing their technologies. Thus, for academics, establishing ASOs is the way of advancing their research or implementing their technology into society (Yamada, 2015).

Second, non-academics often engage in ASOs as business specialists. Most academics focus on technology rather than market needs, so they tend to be lacking the view of market needs (Shane, 2004). In general, academics are familiar with academic fields,

but they do not have enough business knowledge and experience. Therefore, non-academic specialists participate in the team in order to provide business skills and knowledge to ASOs. As such, founding teams which involve academics and non-academics attribute ASOs to balance R&D and economic achievement (Visintin and Pittino, 2014).

Previous studies show that ASOs which involve academics and non-academics tend to have high performance (Doutriaux and Barker, 1995, Chrisman, et al 1995). This is because members can focus on their fields of experts (Preston, 1997). Visintin and Pittino(2014) analyzed the relationship between composition of founding members and performance in a quantitative way. In this study, they observed ASOs' performance for three years and confirmed whether co-existence of academics and non-academics have positive influence for the performance. As a result, they proved that the founding team which involves academics and non-academics attribute ASOs to balance R&D and economic achievement (Visintin and Pittino, 2014). However, except for a few empirical studies on team formation in ASOs as introduced above, we know little about what is actually happening in the process of ASOs' team building. While existing studies on this topic shed light on the positive side of human resources with diverse backgrounds, it is questionable whether this is always the case. In addition, although there are various studies about individual topics on HRM of ASOs, for example, characteristic of founding members and academics' motivation for establishing ASOs (Matsuoka & Yamada, 2010:

McQueen & Wallmark, 1982; Shane, 2003), few studies have focused on dynamic phenomenon such as how ASOs form teams in the process of growth from the beginning to achievement of commercialization. Therefore, our study explores the dynamic process of team building in ASOs, focusing on how academics and non-academics develop a well-coordinated team and manage the growth of ASOs.

### **3. METHODOLOGY**

#### **3-1. Research Method**

Case studies are an effective way to clarify the mechanism that explains complex social phenomena in which the intentions of multiple subjects intersect (Sato, 2008). We adopted the case study approach of Eisenhardt (1989) for preparation in advance and the grounded theory of Glasser and Strauss (1967) for data analysis. The case study approach of Eisenhardt (1989) is a research method to clarify the research problem before investigation by examining previous research. However, building a strict theoretical framework make it less possible to discover a new theory and break through the existing theories. Therefore, we have to use it only when setting a preliminary research question (Yokozawa, 2013). Through literature reviews, we focus on ‘human resources in ASOs’ from both industries and academia, to draw out more concrete research questions. This method enables a flexible analytical process based on the

method of Eisenhardt (1989), as Sato (2008) points out.

Grounded theory is an analysis method that discovers new concepts through coding analysis by analyzing the data obtained from the surveyed objects, and finally creates a theory from the field data (Yamada, 2015). Based on the above grounded theory, we proceed with data collection and data analysis in a parallel manner. Also, while conducting interviews, we select the opposite cases and change the interview items in order to extend and reinforce the theory emerging from the data. By repeating these processes, we aim to clarify the context of team formation during the founding period of ASOs.

### **3-2. Data Collection**

In order to find the answer to our research question, we analyzed five cases of ASOs from Tohoku University. There are two reasons why we selected ASOs of Tohoku University. First, Tohoku University is one of the most advanced universities in Japan in terms of ASOs activities. Tohoku University is conducting research at the top level in Japan in various fields of science, and has been actively promoting industry-academia collaboration in recent years. Tohoku University aims to create 100 ASO's by 2030, and provides a wide range of support for venture companies, from fostering entrepreneurship to hands-on support. In addition, research on ASOs is concentrated in cases in Europe and the United States, and there is almost no research in Japan. Second, we belong to

the same university and have relatively high accessibility to ASOs in Tohoku University. Therefore, we can attain deeper and richer information, which is often the biggest challenge for qualitative research. Although contacting ASOs and getting permission for our research was never easy, we believe our research team has an advantage to approach our informants who opened their mind to us and told rich stories from their establishment. This is one of the most critical conditions for this type of research. For these reasons, ASOs in Tohoku University have sufficient validity as our research context in Japan in order to clarify the dynamics of team formation.

Our data collection took two steps. First, we requested interviews with two VCs to grasp overall activities of ASOs in Tohoku University, as shown in Table 3-1. Through interviews with VCs, we found that one of the biggest difficulties of managing ASOs is to balance members' different perspectives of business and academia. Then, second, we requested interviews to 13 representative ASOs, and 5 of them agreed to participate in our interview. We chose the interviewees under the condition that we can access the opinions of both researchers and managers. Table 3-2 outlines the companies interviewed, and Table 3-3 details the interview.

Table 3-1 Interview details (VC)

Company name	Interview target	Interview date and time	Interview location
A(VC)	Investor A	2020/8/5 10:00~12:35	Online
B(VC)	Investor B	2020/8/17 10:00~12:00	Online

Table3-2 Overview of sample companies

Company name	Business content	Date of establishment (year/month)	Capital stock (JPY)
A	Sensor development etc..	2015/11	100,000,000
B	Crystal fabrication etc..	2012/11	5500,000

C	Manufacture and sale of materials for solar cells etc..	2017/9	67,750,000
D	Material development and manufacturing etc..	2015/11	995,900,000
E	Development of electronic components and their materials etc..	2014/12	274,640,000



Table3-3 Interview details of ASOs

Company name	Interviewees	Interview date and time (year/month/date/time)	Interview location
A	Researcher P	2020/8/3 15:00~19:00	Company office
	Researcher Q	2020//8/3 18:00~19:00	Company office
	Manager R	2020/9/18 13:00~15:00	Online
B	Researcher and Manager S	2020/9/17 10:00~12:00	Online
C	Researcher and Manager T	2020/8/21 10:00~11:30	Company office
D	Manager U	2020/8/26 10:00 ~ 12:00	Company office
E	Researcher S	2020/9/17 10:00~12:00	Online

As a result, we finally interviewed the people (researchers and managers) who were involved in the establishments of five ASOs from Tohoku University, and the investors

from two venture capitals (below VC) investing in those ASOs. In the interview, we asked a wide range of questions including: background of starting the business, nature and development process of technology into business, background of team members, challenges in managing the teams, and path of business development and current situation as well as future plan. In addition, the analysis was supplemented with secondary data such as websites, press releases, and pamphlets of each company. The results of our analysis will be explained in the next section.

#### 4. FINDINGS

The following sections explain three constructs emerged from our data analysis, followed by how these constructs are interrelated as shown in our theoretical model (Figure 1).

**Figure1: Overview of team building in ASOs**

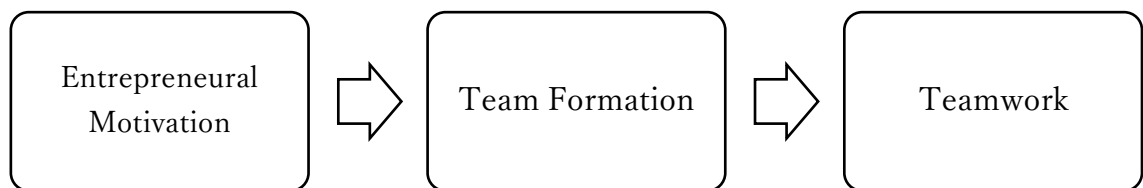


Table 4-1 summarize the findings of our multiple case study. We will explain about the three constructs in the following section.

**Table4-1 Team formation process of ASOs**

	Establish Motivation	Team Formation	Teamwork
Company A, B and C	Defensive motivation	Homogenous	Collaboration
Company D and E	Aggressive motivation	Heterogenous	Conflict

#### 4-1. The Definitions of Three Constructs

##### 4-1-1. Entrepreneurial Motivations

In our cases, there are two types of entrepreneurial motivation, which we call *aggressive motivation* and *defensive motivation*. Aggressive motivation is defined as to establish an ASO in order to proactively seek business opportunity. In ASO, when people involved in the scientific resources in the university (a discoverer, partners in the university, and external people in industry) appreciate the resources and detect potential of great profits, some of them establish an ASO (Schendel & Hitt, 2007). They often are encouraged from investors and business people to establish an ASO to capitalize the discovery in the university lab. Two of our cases, D and E are established by aggressive motivation, as highlighted by the following quotations: *“Many companies were interested in our technology and conducting joint research. For the university, it was more profitable to establish an ASO, so we decided to start the business. [...] In my opinion, if*

*our technology is used in the future all over the world, we wouldn't need any nuclear power plant”*

However, this is not always the case. The second category is defensive motivation, which we define to reluctantly establish an ASO in order to continue an ongoing research project. Scientists often lose the ways to make their findings utilized in society due to the environmental changes and the stop of joint research (Meyer, 2003).. Three of our cases, A, B, and C are established by defensive motivation, as exemplified by the following two quotations:

*“I was working with the company on the joint research because I wanted to commercialize my finding and make it utilized in society. However, the company shelved the project because the technology was not in line with their business. At that stage, I noticed that I had no choice but to start business on my own.”*

*“The company ended up quitting the business, but I wanted to continue the research, and if so, the technology would disappear, and this excellent technology would never be utilized, I thought it was too regrettable.”*

#### **4-1-2. Team Formation**

From our data analysis, two types of team formation have emerged, which we labeled *heterogeneous team* and *homogeneous team*. First, a heterogeneous team is defined as an ASO composed of people from both industry and academia. Two of our cases, D and

E are categorized as heterogeneous team, in which key team members are composed by core-technology discoverer and managers from large companies who specialize in market strategy.

Second, a homogeneous team is defined as an ASO composed of members who have similar science-based principles or common experiences in joint research. Three of our cases, A, B and C are categorized as homogeneous team, that is composed of people sharing academic value.

Team members are characterized by having an intensive interest in the core-technology and science itself. In addition, they often have a previous relationship of cooperation and strong mutual trust, as highlighted in the following quotation;

*“We often discussed our plan all night, [...] we can make continuous endeavors because we all simply believe our technology is interesting.”*

#### **4-1-3. Teamwork**

We categorized two characteristics of teamwork from our data analysis: conflict and cooperation.

First, conflicting teamwork is defined as not harmonious and cooperative mood of the team members of ASOs in the process of business development.

Company D had a conflict over whether to outsource the production to an outside organization. Then, the company did not commission the work, and the team members

stopped staying together. Eventually the R&D and business were significantly held up by this separation.

One manager of the company described such negative effects from the conflict as follows;

*“The development of the technology has been too behind the original plan. We have finally sorted out all the ties and stuff we have had to deal with. To be honest, we need and wish for help by the professor, but [...] (we cannot ask for help anymore)”*

In the team of company E, an industry-based perspective was in conflict with an academia-based perspective when dealing with financial strategy. Eventually after a discussion for months, they received large investments and increased the size of their business by establishing another spin-off, but the discoverers of the technology were no longer deeply involved in the business.

Second, cooperative teamwork is defined as harmonious and well-coordinated mood of the team members of ASOs in the process of business development. The team in company A, B and C works well together to run the business. All of the teammates approve the desires of the researchers in the academic side, and the experts around them coordinate the business to achieve it. In fact, manager R of Company A describes the team's collaborative system as follows, by an analogy to the human body system.

*“Our team does business in a style where Researcher P is the brains of the team, with the rest of the team playing the role of the legs and eyes.”*

Researcher S of Company C who is also a manager describes his team working together with a shared scientific perspective as follows;

*“We, scientists are interested not in manufacturing products, but new scientific findings, so that I leave that part to my team members who are specialized in it. We're following a step-by-step strategy of expanding our business that starts from a niche market, and everyone on board agrees with it.”*

#### **4-2. How an Establishment Motivation Affects the Team Formation**

What kind of people join the team and what kind of team is formed in a ASO depends on the two motivations mentioned above: aggressive and defensive. The difference in these motivations influences the way human resources is selected.

##### **4-2-1. How an Aggressive Motivation Affects the Team-building**

Aggressive motivation is likely to lead the heterogeneous team. The establishment of a company from this aggressive motivation means that the core technology is highly valued from the beginning, so that many outsiders from industry tend to join the team, who have business knowhow that cannot be complemented only by human resources from academia. People like those who have worked in a large company having been responsible for managing production, also participate and some investor funding to the team only for returns.

These teams are characterized by the participation of industry-side resources beyond former relationships to achieve more effective and more profitable innovation. The human resources in academia lack the know-how to run a company and manage mass production, so it is certainly difficult to commercialize the technology in a team centered on the scientific side and it is very reasonable to ask people with experience in large companies to participate. A high appreciation of the potential of the core technology also makes it relatively easy to raise funds and recover talent. The process of forming the founding team is described by manager U of company D and a researcher S of Company E as follows;

*“A lot of people, including me, have been dispatched from various companies. I came from (a large company). One person from (another large company) and one person from (another large company) came to work as the first president of the company.”*

*“The team at Company E was originally a team in Company B. When we started a new business to commercialize the new technology, people who were originally at (a large company) joined the team.”*

In this way, teams in a company established by aggressive motivation are built selecting the human resources required on the commercialization pathway from industries that are outside of academia.

#### **4-2-2. How a Defensive Motivation Affects the Team-building**



Defensive motivation is likely to lead the homogeneous team. When a company is established by defensive motivation, few people are actively involved from the outside. The value of unappreciated and abandoned research on core technologies is impossible to understand from people in industry. Only those who believe the social and scientific value of the core technology and have emotional commitment, a kind of love to the technology itself will participate in ASO. This includes a desire to continue the research and a desire to make it evaluated in society. Such human resources must be limited to those who have been involved with the technology or its discoverers, and among them only those who accept the risk will finally join the ASO.

In our cases of the team in company A, researcher P first asked for help from one of the researchers with whom he was collaborating, and he joined as CEO (manager P). In addition, a person specializing in producing devices (researcher Q) and a person responsible for business strategy participated from the joint research team as well as the CEO. All of them had been involved in the research of the core technology for a long period of time together with researcher P, and relationship of mutual trust in advance. All of them were specialized in the core technology and surrounding scientific disciplines, and also had a shared desire to contribute (especially domestic) science and develop the research, which could be said as an academic-based principle.

Manager P described the team-building process and his feeling for the core-technology as follows:

*“There were many people involved in the research, but only four of us were left in the end. We were screened over time, and I think we all believed the finding was interesting enough to stay until the end.”*

They were all researchers, but they have learned and complemented the skills needed for their given posts like CEO or CFO.

In a team of company B, no one from researcher Q's laboratory agreed with their participation in the establishment of the company, but receiving the request of Q, an alumnus of the laboratory decided to participate in the ASO as the president of the company. He worked as a researcher at a large company at that time and was fed up with the inflexible customs of that company, so he joined the team to help researcher Q with his business. Researcher Q also asked his wife to be CFO, and then the team members were members who had already established a relationship of mutual trust with researcher Q. Because the team operated with minimal financing and few stakeholders, the team is like an extension of the lab, with a strong academic signature and high degree of freedom of researchers.

Researcher Q told the story about how difficult it was to find a team member as shown in the following quote;

*“My colleagues in the lab said that it sounded interesting, but they never agree to participate in it. [...] (the president) was the last student I had when I was an assistant professor. He had excellent abilities, but he was unfairly valued and frustrated by the*

*rigid corporate practices. I got him to join the lab as an associate professor and ask to work as a president.”*

In this way, in companies established by this defensive motivation, the team members are those who have worked with the discoverer of the technology and owe emotional commitment to the technology, which makes the team more homogeneous.

Both of the above two patterns of team-building could be said to have been carried out reasonably based on the entrepreneurial motivation the founders have. In other words, the degree of how homogeneous the team depends on entrepreneurial motivations.

#### **4-3. How Team Formation Affects Teamwork**

The degree of how homogeneous the team members affects their teamwork. Conflicts in teams of company D and E come from its heterogeneity, and cooperation in company A, B and C comes from homogeneity.

##### **4-3-1. How a Heterogeneous Team Come into Conflict**

In our cases, serious conflicts that affected the business arose in highly heterogeneous teams. Team members of company D and E did not have a sufficiently tied relationship of mutual trust because each member of them came from a different company and had no connection with academia. It can be said that they are typical teams that have human resources from both academia and industry.

In Company D, the team was so cooperative that the researcher transferred all of his patents required for business to the company, but a conflict arose when discussing how they produced their product. The industry related to the core technology has been developed in a foreign country, and outsourcing its production to another company it was possible to manufacture products more efficiently, which means to achieve innovation. However, outsourcing production without developing it on themselves brings a great risk of damaging the company's superiority, stability, and profits.

Therefore, the president from a large company insisted that they should do more research and development by themselves even if it takes a lot of time.

But the discoverer of the technology insisted that production should be outsourced, because from his perspective built in academia, that policy is highly wasteful for simply making the technology utilized in society. The underlying wide cognitive gap between them became manifest in front of a big barrier.

As a result, this conflict in policy significantly delayed the promotion of business by company D.

Manager U of company D shared the cognitive gap underlying this conflict as follows:

*“University researchers and companies have different sense of time for technology commercialization. [...] In our case, the researchers initially let us do the business as we like, but after a while, I think he couldn't stand anymore the slow speed of companies that have to go through various procedures and the policy of taking great care of risks.*

*[...] I think he was humbled about that in early years, [...] The biggest difference is that their opinions are unrealistic. If technically possible, they suppose commercialization can be done in the most efficient way immediately in their heads. People in business can't accept it so easily. [...] Companies have considered more and more backup plans and most of them are not accepted for various reasons in the end. [...] There is a gap in what scientists want to achieve and what companies want to achieve.”*

From this case, it can be seen that there is a wide cognitive gap that cannot be easily resolved between business people and academics. A conflict arose between scientists, who want to make scientific contributions without any restriction, and business people, who want to stand significantly in the market and avoid risks as much as possible, when they faced challenging problems.

There was this kind of wide cognitive gap in company E, and Professor S explained his impression as follows:

*“The first conflict arose was when five people from a big company join us. They even said " it's totally not a company". We disagree over various aspects from usual customs to growth strategies. They took the means of spin-out because the direction was different from ours, which is steady. [...] Still, we had an awkward atmosphere for about half a year. If the direction is different, teamwork doesn't work well. It's okay to think differently, but I can't give up my identity (as a scientist). “*

The team in Company E argued over whether to keep their gradual strategy or jump to grow with a large investment. He explained his business and his identity as follows:

*“We have a good cycle of gradually expanding our market share in niche markets, doing a lot of research with fading back from the market, and writing a lot of papers. [...] I avoided to receive a large investment like other ventures receive because my discretion is reduced and I can't research freely like that.”*

The researchers' degree of freedom also strongly motivated them, and researchers tend to avoid hiring other interested people who might damage it.

The priorities of each member of the ASO depend on the careers they have experienced.

A researcher's priority is to discover a new technology and have it accepted and used in society to make society better, while a manager from a large corporation's priority is to ensure the company's long-term survival and successfully grow.

Thus, this highly heterogeneous team has different knowledge, their own specialized fields and the priorities and it is very difficult to find a compromise. As a result, team members are in conflict. This is a contradiction that arises despite the high technological potential and the gathering of highly specialized human resources in various fields in order to achieve innovation effectively.

#### **4-3-2. How a Homogeneous Team Come into Collaboration**

In our cases, Homogeneous teams worked well together. Regarding human resources management, teams A, B, and C have no problems that affect the business. Each member trusted each other and acquired abilities that were lacking for achieving goals such as company management mainly through learning. This was mainly because each member had a strong interest in the technology itself, and this strong emotional commitment to science was the driving force to work together to overcome various challenges in company management, including lack of skills. Being in the same scientific position meant that the cognitive gap was small, which allowed them to make unified decisions in every situation.

In Company A, all members are familiar with the science of the core-technology and fields around this, and share the sense of value based on scientific contributions and academia-based principles. Regarding the purpose shared by the team, manager P of company A states as follows;

*“Researcher Q creates sustainable commercialization, a CFO makes new strategies to raise money and researcher R creates scientific innovation. In this way, we try to realize a vision that scientists help the world.”*

In Company C, researcher T makes most of the decisions as a manager with a good understanding of core technology as a scientist.

T in company C states that this is an important factor in maintaining good cooperation.

*“Our strength is that I know how much time it takes to do research and development and how difficult it is, which enables me make a reasonable decision”*

Of course, even if they have the same background, there is a cognitive gap between those who have partly been in industry and the full academic because of their normal difference in disciplines and ways of thinking, and every team has cognitive gap whether it is wide or not.

However, team members in homogeneous team share the foundation of science and everyone has an emotional commitment and interest in core-technologies. This commitment to core-technology is the foundation of relationships of mutual trust and leads to mutual respect.

Researcher P of company Q describes the words that symbolize this relationship of trust and compromise as follows:

*“They had been doing research in the corporation and I have been doing it in public research institutions. I often feel that they think differently because of our different backgrounds but we can communicate through science as a language, and even though ASO was born out from a university, it's a company, and the way people who had experienced a company think is very important in running it, so I believed that it was reasonable for the commercialization of our technology although I felt uncomfortable about that at first.”*



In homogeneous teams, the cognitive gap is extremely small, which makes problems of decision-making policy easily solved, so the gap does not develop into conflict, and R & D is cooperatively conducted by academics and non-academics.

As a result, cooperative interactions are facilitating, and it is possible to manage all resources effectively and move the business forward more efficiently than a highly heterogeneous team. Each of them respects and works together for the common purpose of social implementation of core technologies.

In this way, the homogeneity and heterogeneity of team members determines the width of the cognitive gap, which decisively influences teamwork.

The process of team-building before and after establishment of ASO can be logically interpreted by the above three constructs and way of selecting human resources and the cognitive gap.

## **5. DISCUSSION**

In this paper, we investigated team-building before and after the establishment of a company from a dynamic viewpoint, and built a theoretical model based on detailed interviews. That model presents the background and results of team-building in ASOs. The background and the entrepreneurial motivation of an ASO affects what kinds of people join the company, which influences whether team members can work well together or not. This follow-up to cases is a challenging theme (Yamada, 2015), our study

provides an understanding on early team formation of ASOs in Japan

### **5-1. Theoretical Implications**

Our study made three academic contributions. First, our study extends and develops existing studies on ASOs, providing a dynamic perspective that integrates individual findings of previous studies into a consistent theoretical explanation. In other words, while previous studies highlight a certain dimension of HRM in ASOs, such as members with a variety of backgrounds, conflicts, balance of top managers, our in-depth case studies shed light on the process of how these existing findings are interconnected. With this finding, our study suggests that it is necessary to understand the establishment motivation and member selection in order to confront the consequent result of conflicts or coordination among members. This perspective enables us to grasp the dynamic process of team-building in a ASO as a consistent story.

Second, we managed to deal with cases that have significant problems in team-building. Considering Most previous studies on ASOs discuss successful cases (Yamada2015: Stefan, 2019), we had a very rare chance to reveal the real challenges of ASOs. We believe our relatively high accessibility to ASOs in the same university allowed us to approach the reality that included negative aspects. This will greatly contribute to the accumulation of information about ASOs in Japan.

Third, more broadly, our findings contribute also to research of human resource management in innovation management. In the field of innovation management, many studies have discussed how different two kinds of human resources with different backgrounds collaborate for cooperate for required for technology creation and its commercialization are, and how they collaborate. The gap between academic and business members that exists between team members in ASOs is very broad compared with other cases such as companies and ventures. an extremely broad gap of academic and business. In other words, ASOs are This is the most characterized case in terms of such heterogeneity. Therefore, our findings in these extreme contexts of ASOs Such cases can provide insights also be applied to large companies, which are the main stream of innovation management, and also give deep suggestions for the consideration of teambuilding in common technology ventures for which consideration has not been accumulated.

## **5-2. Managerial Implications**

Our research provides two practical Implications. First, stakeholders need to be involved in ASO, taking into account the cognitive gaps of people with different backgrounds in academia and industry. A team in ASOs cannot achieve innovation without principles of both academia and industry.

In our case, a team of heterogeneous ASO companies, founded by positive motivation and bringing together different professionals to innovate efficiently, are in conflict and eventually perform inefficiently. Such heterogeneous teams were thought to drive innovation, which contradicts these cases. This fact gives ASO management practical advice. In other words, when establishing a company with aggressive motivation, management should devise not only ability but also devise to solve cognitive gaps and collect key human resources who can solve it. By taking this into account, ASO can reduce the risk of conflict between team members when making decisions.

Second, promoting ASO's business centered on academics can have a positive impact on innovation. Highly homogeneous teams were said to be hard to innovate, but the ASO, founded by defensive motivation, is able to drive innovation. Academic graduates have a deep knowledge of their expertise and can gain a deeper understanding of market needs that are strongly relevant to their area of expertise. In addition, they can play an active role in sales and new business proposals based on their many years of experience in collaborative research with industry.

Thus, our research suggests the effectiveness of having academics involved in business during the founding period.

### **5-3. Limitations and Suggestions for Further Research**

Despite of these contributions, our research has two limitations that require future research. First of all, in our cases, we were unable to get information from all the members who belong to the team of each ASOs due to the limitation of time and its difficulty. Although we tried to collect data as fairly as possible, we could not make a successful contact with both members of academics and business in some ASOs in our sample. Therefore, future studies with a more balanced data collection strategy would strengthen our findings.

Second, in terms of cognitive gaps and collaboration, this paper interprets that the cognitive gap is small in homogeneous team formation, which enables the collaboration. However, our distinction of small/big cognitive gap might be very rough, thus need to be brushed up in future studies. We tried to simplify the distinction in order to develop as clear theoretical model as possible. Although we recognized there might be a more nuanced spectrum of cognitive gaps and various approaches to deal with the gaps, we did not illustrate too much details for the sake of high abstrusity of the model. Therefore, our simplified model opens various possibilities to investigate more into the individual constructs and relationships between constructs.

### **Acknowledgment**

We are deeply grateful for all interviewees.

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