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## **Innovation as a Dynamic Process:**

An actor-network theory study of product development in the  
forest industry

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# **Innovation as a Dynamic Process:**

An Actor Network Study of Product Development in the Forest Industry

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## **Abstract**

*The importance of innovation and new product development in the globalized contemporary world is substantial. Previous research within the discourse have tended to focus on the differences between organizations and their ability to innovate based on size, sector and taxonomies as innovation drivers. Recently the focus has partly changed to open innovation and sharing innovation, with network being an important aspect. However, little research has been devoted to understanding innovation as a more complete and dynamic process. This article is based on an innovation case in the Swedish forest industry and takes an actor network theory approach to understand innovation as a dynamic process, moving beyond organizational boundaries. It traces back how the actor network has emerged over a ten-year period of time and points to key chapters in the actor-network narrative. The study identifies five obligatory points of passage that are important for an innovation process and points to the importance of interessement devices and enrollment. It takes a critical approach to the previous research based on innovation not being a static state of being but a moving and dynamic process where actants, regardless of their organizational origin, make up the innovation process.*

## **Keywords**

Innovation, New Product Development, Process, Actor Network Theory, Enrollment

## **Introduction**

The importance of new product development and innovation is considered by OECD (2000) to be one of the major driving forces behind economic growth. One reason for the increase in innovation can be found in the heightened levels of competition and the struggle for the survival of the firm. Some scholars directly relate companies' ability to innovate and develop new products to the survival of the firm (Pullen, de Weerd-Nederhof, Groen & Fisscher, 2012). With increased levels of competition resources become scarce (Killen, Hunt & Kleinschmidt, 2003), financial risks

increase (Eng & Quaia, 2009; OECD, 2000) and the innovation process can be regarded as a competitive advantage (Gassmann, 2006). Taking risks and being innovative can be rewarding and several authors argue that there is a positive relation between new product development, innovation and organizational performance (Hovgaard & Hansen, 2004; Eng & Quaia, 2009; Frambach, Pabhub & Verhallen, 2003). Some see the ability to innovate and develop new products within the company as a key to gain access to new markets, hinder erosion in margins and to protect current market shares (Killen, Hunt & Kleinschmidt, 2008; Hovgaard & Hansen, 2004; Nicholas, Ledwith & Perks, 2011; OECD, 2000). This is important in all businesses but maybe even more importantly in smaller to medium sized enterprises (SMEs) where margins are narrower (Carson, Gilmore, Cummins, O'Donnel & Grant, 1998).

Much of today's research divides innovation and new product development into taxonomies based on innovation input and output, the innovative nature, innovation intensity and knowledge intensity (de Jong & Marsili, 2006). The innovation and new product development are assumed to be widely different between the taxonomies and heterogeneity increases when the focus is turned to SMEs and smaller firms (de Jong & Marsili, 2006). The empirical level of the taxonomies is based on what industry the organization is active in (Pavitt, 1984; Evangelista, 2000) or the size of the organization (Lee, Park, Park & Yoon, 2009) i.e. large company, SME or micro firm (de Jong & Marsili, 2006). Based on the empirical level and taxonomies, organizations are often attributed perks and shortcomings when it comes to innovation (Hoffman et al., 1998). Some studies argue that SMEs are well positioned in order to identify possible innovations, much due to their closeness to the customer (Millward & Lewis, 2006). Other strengths that are ascribed to SMEs are a shorter decision making processes, a friendlier atmosphere to innovation, less resistance to change and a greater functional integration (Nicholas, Ledwith & Perks, 2011). General shortcomings within SMEs when it comes to innovation and new product development have been considered as lacking external contact, access to resources and having a owner/manager domination (Hadjimanolis, 1999; Kaufmann and Tödting, 2002; Nicholas, Ledwith & Perks, 2011). However, this type of research gives little insight in the actual process of innovation (Dhanasai & Parkhe, 2006). Furthermore, the process takes place in a dynamic environment where relations between organizations matter (Dhanasai & Parkhe, 2006), however the above-mentioned research is often focused on one organization and not the relations between organizations. Then attributing perks and shortcomings based on size and taxonomies is a rather static approach and it should not be considered to be generic.

Increased global competition has made innovators turn to an external approach, sharing the innovation process (Gassmann, 2006) and using innovation networks (Konsti-Laakso, Pihkala & Kraus, 2012; Dhanasai & Parkhe, 2006). One firm, and this is especially true for a smaller firm, cannot possess all the necessary expertise and knowledge. Thus co-operation becomes a viable alternative and opening up the innovation process has become important (Gassmann, 2006; Konsti-Laakso, Pihkala & Kraus, 2012; Lee et al., 2009). Furthermore even smaller firms such as

start-ups are becoming more important for new product development and innovation, however they lack the financial means and managerial experience (OECD, 2000). With the open innovation trend in mind the organizational boundaries becomes blurred and successful innovation as due to structural characteristics or innovative traits becomes static (Edwards, Delbridge & Munday, 2005). Instead a process or a network perspective of innovation allows for deeper understanding of the innovation process by acknowledging the intra-organizational relations and a dynamic environment as well as moving outside the organizational boundaries (Konsti-Laakso, Pihkala & Kraus, 2012). A network approach recognizes the importance of relation but it still divides it in accordance to organizational boundaries. We believe that seeing the actor network behind the product could provide a more fruitful approach in terms of innovation and new product development and understanding the process behind innovation.

Our purpose is to further investigate innovation and new product development from a process and dynamic perspective and we identify five obligatory points of passage. We do this by using Actor Network Theory and focusing on how the actor network has emerged and the role of enrollment and interessement devices, thus zooming out from taxonomies and internal abilities. We shift the focus of our research from studying the single organization to following the product in its development. Having the new product as central foci and studying the actor network connected to it can point to what the innovation process might entail outside the single organization and beyond the above-mentioned taxonomies (Read & Dewa, 2007). We have conducted our study in the context of the forest industry. The development of a product named MultiPro; a product aimed at protecting conifer seedlings from damage by insects is traced back to its origin. Recent development regarding protection from the insect also includes mechanical protection, argued to be more environmentally friendly compared to chemical protection. MultiPro is one of the few mechanical protection solutions available to the industry. By tracing back the journey that MultiPro has undergone from idea to finished product and seeing how the actor network connected to it has developed and emerged we hope to gain a deeper understanding of product innovation, and the processes behind it.

This paper starts with outlining the concepts relevant for this study from actor network theory, it then proceeds to describe the method that has been used which is based in grounded theory. The empirical section starts by describing the setting and then we present four different parts of the narrative of the MultiPro development. Each of the four parts is followed by a short analysis relating the situation to actor network theory. The discussion relates the findings back to innovation and product development and presents five different passage points, as well as the importance of interessement devices and enrollment in innovation and then ends in future implications.

## Introducing Actor-Network Theory

Actor-Network Theory (ANT) is an approach that allows for the mapping of actors and how they are connected to each other through collective activities (Callon, 1991). Since its beginning actor-network theory has been concerned with science in the making and growing of so-called actor networks rather than already made society (Latour, 1987). Actors are human as well as non-human, thus heeding a certain level of symmetry in terms of analysis (Latour, 1987; Law & Callon, 1988). Akrich and Latour (1992) use the term actant rather than actors during the emergence of a network. An actant is anything that does something and becomes an actor first when it does that something repeatedly with similar results. Thus when a stronger identity is established and the actant transforms into an actor. (Akrich & Latour, 1992)

Latour (1987) argues that sociology and technology cannot be separated from each other, instead he means that they are intricately intertwined and mixed together. An example is presented by Latour (1987), today a computer is often taken for granted, and is thus black boxed and assumed to present similar results independent of space and time. But during the construction process, one cannot tell which part is social and which is technical (Latour, 1987). Furthermore, networks unfold as actors create links to each other through mutual interests (Callon, 1986; 1991; Callon & Law, 1982; Law & Callon, 1988; Akrich, 1992). On a similar note Håkansson, Kjellberg & Lundgren (1993) discuss how strategic alliances must be seen as more than dyadic relationships. Instead it must be seen as embedded in networks, where alliances are defined as autonomous firms coordinating their efforts. In other words, being agents in an actor network. Nicolini (2009) points out that an actor owes its position in the network in relation to all the other actors, which is in line with the above arguments as well.

An actor engages in “interest work”, which basically means that they work in order to enroll or enact other entities. By doing this, a mutual interest is created and a link between the two actors is established (Callon & Law, 1982). Intermediaries and mediators are semiotic in nature and thus carry certain amount of meaning or value so that they may influence actors (Nicolini, 2009). According to Callon (1991) the process of enrolling other actors involve intermediaries and these come in four types: (1) in the form of text e.g. as a scientific article or a law, (2) as a technological artifact e.g. as a product or a machine, (3) as a person or (4) in the form of money. When an intermediary passes between different actors, this allows the actors to identify the relationship between them (ibid.). Thus, if a product passes between two actors and they have a mutual interest in that particular intermediary, they will create a link, *through* or *via* the intermediary. Furthermore, an actor can argue for aligned interests with another actor to establish a link and a sort of provisional order, if this succeeds the arguing actor may become an obligatory point of passage (Callon 1986; Law & Callon, 1988). Then an obligatory point of passage is like a gateway that all actors have to pass through in order for the interests to converge. It can be a necessary element for the formation of an actor network. However, if this fails, a remapping of interests and identities may be necessary (Callon & Law, 1982). All entities, actors

and intermediaries together form a network as long as they are bound to each other (Callon, 1991) and thus, owe their particular position in relation to the network as a whole (Nicolini, 2009). Another important fact pointed out by Nicolini (2009) is that this is not a linear happening; instead it must be seen as a process with a less crystallized beginning and end.

A network can be more or less stable, or convergent and divergent (Callon, 1991). When a network is divergent and less stable this has implications of a methodological character, the account has to describe and entail all details since there is constant fluctuation and translation, the network refuses to stabilize. On the other hand, a strongly convergent irreversible network is characterized by the strong presence of norms as well as on homogeneity (ibid). This makes the network more resistant to external actors trying to define or change the identity of a network member by imposing their interest. This situation can be assimilated with a “black box”, meaning that the way it acts is assumed to be predictable, regardless of what context it is placed in (Latour, 1987; Callon, 1991). However, at a different point in time, it might have been much more uncertain, as in the example provided by Latour (1987) and the computer. Rose & Miller (2010) argues that a powerful actor is proven to be so when they are able to mobilize the network into a mutual interest and towards a common goal at a given point in time. Furthermore they believe that the mechanisms of enrollment or the devices of interest are made stronger when they are materialized, e.g. through a machine, architecture or obligations. Eventually, it may become much like a monstrous and scarred Leviathan, a macro structure or a network that acts as if it is one actor (Callon & Latour, 1981).

The enrolling or transformation of other actors is called translation (Callon, 1991). This process involves negotiation between the actor that allows them to determine the other actors’ identities, as well as their own identity (Callon, 1986). Furthermore it should be emphasized that in this process, actors interact with each other, thus they both shape others but are also shaped by others and thus, identities are under constant construction and reconstruction (Callon & Law, 1997; Nicolini, 2009). Or as Czarniawska & Hernes (2005) expresses it, as a tug-of-war, meaning that micro actors and anti-programs are constantly battling the macro actors. Wynne (1992) emphasizes the ambiguities and the possible ambivalence surrounding the creation of identity by arguing that socially constructed identity is always held in tension to other actors in the network. Furthermore, the identities should be seen as “open-ended” since they are hinged upon social construction and if a component related to the identity changes so does the identity (Wynne, 1992). As is evident in Callon’s (1986) example of the scallops in St. Brieuc bay when the fishermen “betray” the researchers.

However, there are also some limitations with the sociology of translation. The focus on whether human or non-human actor is important to either combine or separate from each other can be complex. It concerns merely one of the subjects that will make the other obscure and valuable information considering the actor will not be examined properly. Actors need to be treated equally when undergoing change or innovation in a social context. This is something that is often disregarded when

discussing the sociology of translation. Another limitation is that practitioners are often depicted as “heroes” the entrepreneur as an individual rather than the process itself. (Nicolini, 2009)

## **Methodology**

We followed the traces from the current end to the beginning in order to understand how MultiPro have constructed and reconfigured the actor network that it is attached to. The end of a story chooses its beginning (Czarniawska, 2004), thus tracing back the paths that the idea has travelled is a suitable method to reach the beginning. *Aramis, or The Love of Technology* (Latour, 1996) has been a great source of inspiration for the work that we have done on MultiPro.

After investigating how the actor network has developed we relate it back to innovation and product development to offer an alternative approach, a much more process oriented take on innovation, to taxonomies, internal abilities and traits. In order to do a similar journey, in methodological terms, we adopted a grounded theory approach. This methodological approach was translated by Turner (1981) into “the discovery of theory in data”, which captures the essence of grounded theory. Furthermore it suited our study since it is based on acquired empirical data done through interviews, observations and documents. Grounded theory aims to build theory that is based or “grounded” in the collected field material (Glaser & Strauss, 1967; Turner, 1981; 1983; Martin & Turner, 1986). The collection of field material from interviews, observations and documents was analyzed and discussed in a continuous comparative approach, meaning that the analysis and comparisons was done simultaneously as empirical material was gathered, as argued by Glaser & Strauss (1967) to be a suitable approach.

The choice of utilizing a qualitative approach to this matter is due to our aim of gaining insight, discoveries and interpretation when analyzing a specific process (Simon, 1991). Furthermore, the nature of actor networks make them rather hard to quantify since the focus is primarily on processes and not results. The interviews conducted in this study were based on an ambition to reach a high level of neutrality. This in order to ensure that we could follow MultiPro as observers rather than actors dictating the next step in the development of the product, an ongoing process (Ragnhild, 2008). By keeping the questions open ended we have tried to ensure genuine answers from our interviewees to help understand how the process of MultiPro has unfolded and how it still is developing from their perspective, letting the interviewees associate freely (Ragnhild, 2008).

### **Collection of field material**

We have utilized several methods for collecting relevant field material, namely interviews, observations and document analysis. This in order to gain complete and nuanced information of how connections are interconnected among the actors and the

actants studied in this paper. This also serves as a method of triangulation, cross-checking the information (Silverman, 2011).

The interview process stretched from early February 2016 to late April 2016, with each interview taking approximately 40 minutes to one hour to complete. In order to find suitable interviewees we let the interviewees guide us towards the next interview and these amounted to 15 interviews. By asking the interviewee whom they thought to be important for how they came in contact with MultiPro, the actor network members aided us in discovering and mapping the network. In other words we used what Kvale & Brinkmann (2008) label as the snowball effect. We could identify different tiers of interviewees that guided us towards new information until we felt saturated on knowledge to see interconnections and relationships created by MultiPro (See appendix A). We began our interviews with the CEO of Cellmark and then continued our interviews based on recommendations and guidance to be able to trace each connection of the network, without interfering. Other interviewees varied from experts on the large weevil, plant schools to large firms within the forest industry. Our next step from the CEO of Cellmark was the project manager for MultiPro at Cellmark and the manager of the manufacturing site where MultiPro is produced. The project manager guided us towards Cellmark's CFO and the manufacturing manager guided us to several actors within the forest industry such as plant schools, the founder of MultiPro, biology researchers and representatives from public institutions connected to MultiPro. Moreover, all of the first tier interviewees guided towards the next tier and so forth until we reached the third and final tier of interviewees. The third tier did not add any new information or insights, which was the incentive to us feeling saturated on information.

We prepared each interview beforehand by creating a template of questions. The templates varied depending on whom the interview was with. For example if the interviewee was an expert on the large weevil's biology the questions were modified to our aim of understanding the aforementioned topic. Likewise when it came to interviewing the plant manager of Hylte Converting the questions were modified according to our aim of understanding how the MultiPro is manufactured and why Hylte Converting is the facility for manufacturing. Furthermore some financial and/or biological definitions were replaced by descriptions of the specific terminology to ensure an overall understanding by all our interviewees. Frequently used definitions such as "the large weevil" and "profitability" were explained in a generic manner to ease any potential misunderstandings, thereby ensuring a shared understanding of our interview questions by all interviewees, as argued by Floyd & Fowler (2009). We encouraged a narrative mode by opening each interview session with questions like "Would you please describe your role and your background?" and "Would you describe how you came in contact with MultiPro the first time?" Even though we created templates on beforehand we used a loosely coupled approach to these in order to encourage detours during the interview and to let the interviewee talk freely of what actors they considered as important. Using Alvesson's (2003) ideas about reflexive pragmatism was an intentional strategy from our part in accentuating the



interviewee's identity. For example by being loosely coupled to our interview questions and being keen on exploring subjects that came up during the interviews.

The interviewee might be inclined to give the "correct answer" trying to please the interviewer (Czarniawska, 2014; Czarniawska & Jorges, 1996) or portray his/her organization in a favorable light (Van Maanen, 2011; Kvale, 2006), rather than an honest answer. We acted as outsiders without being biased towards our interviewees and thus we could stimulate open discussions where the interviewees felt comfortable in answering all questions. We made sure that we had nothing to gain from the interviewee's answers more than gaining an insight on knowledge from the interviewee. Kvale & Brinkmann (2008) argue that it is in fact important being an outsider since it will add to the limited amount of knowledge considering important actors involved. This could also be seen as adding to the level of neutrality between the interviewer and the interviewee, meaning that neither parts have anything to gain from a specific answer (Moore, 2003; Fehrenbach & Hubbard, 2014; McCorkle & Reese, 2005).

In addition to interviewing we also observed certain geographic locations as a complement to our interviews such as Asa Försökspark and the manufacturing site at Hylte Converting. In regards to the observations we mainly investigated unforeseen actions occurring when visiting manufacturing sites, plant schools or other venues that would give further depth to the accumulated information. The observations gave us additional information regarding the conifer plants and the manufacturing process of MultiPro. Dutka & Frankel (1993) supports this by arguing that observation methods are a mean of gaining an even deeper understanding of organizational data analyses. Moreover, the observations could be seen as a compliment to other qualitative methods of drawing upon organizational data (Dutka & Frankel, 1993). We identified a significant amount of observations that added further depth to our qualitative data, mainly within the manufacturing site in Hylte and in the test park at Asa. Both aforementioned observations were made in combination with conducting interviews at the sites.

The third and last method of collecting data was documents analysis. Mainly this was directed at test results and reports on MultiPro, annual reports of Cellmark and Sveaskog, press releases and biological data about the large weevil. The document analysis gave us a broader understanding of the financial situation and development of the forest industry considering mechanical protection. Together these three sources of data have been used as a method of triangulation and reference cross checking (Silverman, 2011).

### **Coding and Memoing**

The interviews were transcribed in verbatim while the field notes were expanded as soon as possible after they had been scribbled down, as advocated by Martin & Turner (1986). This together yielded a substantial amount of data, over 100 pages of transcribed interviews, reports amounting to over 500 pages as well as field observations. This can be one of the main problems with qualitative data, the sheer amount of data that might be collected, as well as the fact that the data is often not

standardized (Turner 1981; 1983; Martin & Turner, 1986). Grounded theory offers a partial solution to this, by coding the material and noting them as concepts and categorizing the data so that these conceptual proofs might be easily accessed and scrutinized (Turner, 1981). When the coding took place, a new incident that was coded was also compared to already established categories and concepts, and if it matched a concept it was added and if not, a new concept was created. In essence, the concepts stood as illustration for the conceptual idea of what happened in that particular incident (Glaser & Strauss, 1967). The coding and conceptual categorization was done continuously so that the collection of field material, coding and analysis was done as jointly as possible, which is one of the major strengths with grounded theory (Glaser & Strauss, 1967). The accounts were organized into concepts cards, for example chemicals, mechanical protection devices, the bare root conifer seedlings and Sveaskog. It is important that these concepts are not just a numerical way of organizing; instead it is a first move in the levels of abstraction (Turner, 1981 and Martin & Turner, 1986).

Interviews and field notes were collected until the developed categories felt saturated (Glaser & Strauss, 1967; Turner, 1981) as they traveled down to the third tier. This occurred at different stages for the respective categories, for example the category involving concepts around the weevil's biology had its fill rather early in the process whilst uncertainties regarding the negotiations between Sveaskog and Cellmark felt saturated at a later point in time. Again this is a natural part of the continuous comparative analysis that takes place (Martin & Turner, 1986). The next part in the analysis process is that the concepts are to be connected to actor network theory, as part of the data analysis. For example by identifying obligatory points of passage and relations between the actors. This, according to Martin & Turner (1986) is another move across the layers of abstraction. Establishing or finding links between the concept cards and how they play out in an emerging network in relation to ANT.

In total, the open coding was sorted into 29 concepts, for example: "The large Weevil", "Asa Försökspark" and "Sveaskog". By organizing the open codes in concepts it was possible to understand how the actor network has developed and how the different categories are related to each other. All categories are interrelated somehow, but what is important is that some relations would not *necessarily* have been established without the emergence of the MultiPro actor network. The concepts were in turn divided into eight main categories. For example: the large weevil, MultiPro, negotiations, regulatory standards and Sveaskog. Further these categories were divided into four key processes in the narrative about the MultiPro: "From an Idea to a Business", "Passing the Test", "The Decree of Fate" and "MultiPro at a Crossroad". These four processes were based on different accounts that coupled together created clusters of collective action, which then was turned into a narrative (Czarniawska & Gagliardi, 2003). The four chapters of the narrative are interrelated and presented in a chronological order. By establishing a chronological order, it becomes more graspable to understand the development process that MultiPro is involved in, and still maintaining an actor network approach. This is case specific and keeping in mind that it is process and not sequential is important.

## Combining ANT and Grounded Theory

We believe that grounded theory and ANT is a good fit for each other since grounded theory acknowledge that there are multiple accounts as well as a favorable approach to processes (Strauss & Corbin, 1994). On a similar note ANT, emphasizes a network with multiple actors as well as understanding that this is an ongoing process of negotiations (Callon, 1986). Both grounded theory and ANT are rather unprejudiced in their nature. The starting point for us, the MultiPro that is, is at the same time a result of an actor network, and the MultiPro might be seen as one product, or as an end. What is important to keep in mind, as argued by Czarniawska (2004) is that the end chooses its beginning. Thus tracing back the journey that MultiPro has done helps us understand how MultiPro has changed, and been changed by, the configurations and identity of the network connected to it, as it has moved from idea to reality. One of the main critiques of grounded theory as an approach is that it relies heavily on the empirical findings and thus neglects much of earlier accounts and theories (Parker & Roffey, 1997). ANT helps us understand how this journey has taken place, and a grounded theoretical approach helps us organize the process.

## Empirical Findings

We begin by outlining the main actants, the protagonist and antagonist of the narrative as will be conceptualized. The empirical findings are organized in four different chapters of the narrative by extracting the main accounts from the data as guidelines into the focal points of the narrative. Furthermore, actants are outlined to help the reader in understanding its specific role in the narrative and to create a general setting.

### The Antagonist and The Protagonist

#### The Large Weevil

The large weevil or formally named *hylobius abietis* has been mocking the forest industry for a long time, and is the antagonist in the narrative about MultiPro. The fully developed large weevil is 8-14 mm long with a brown and black coating on its surface. The dominant species is spread out over all of Europe and Asia, gnawing on mainly coniferous and deciduous wood. The further north one looks the less common it becomes. The large weevil's main source of food is the bark around newly planted conifer seedlings for the first three years of the conifer's life. Which areas that gets "infected" is quite random and the insect can smell newly cut wood and hence, can be very local. The damage in terms of dead seedlings can mount to 80-90% of the total planted seedlings. (Ecologist Skogsstyrelsen, 2016; SLU, 2016; Research Assistant Asa Försökspark, 2016; Wainhouse, Brough & Greenacre, 2007)

#### Protection Devices

Since the damage caused by the large weevil can be devastating, the forest industry has always been in need of protection. Today it comes in two forms, either chemical or mechanical. Chemical protection is at the moment being phased out, however

slowly (Bergqvist & Granath Limstrand, 2013). Mechanical protections against the weevil can be divided into two main groups: protective coating or barrier protection. The former works in the way that some type of wax is applied to the plant, 10-15 cm from the bottom that stops the insect from gnaw at the bark. The second type, barrier protection, is often constructed as a mechanical barrier that the weevil cannot or do not want to climb over and thus protect the plant. (Skogsstyrelsen, 2015)

### **MultiPro**

The MultiPro is the protagonist in its narrative. It is a barrier protection type and its design it is formed as a cylinder, with diameter about 6 cm, with its top ending in a cone, with a small hole on top. Along the sides there are two horizontal rows of small holes that allows air to flow through to the plant, so that mold will not develop. The height of the cylinder is about 25 cm. The cylinder is placed over the conifer seedling so that the top of the seedling peeks



Figure 1 MultiPro in the Field

through the hole, allowing it to sprout freely. It is applied manually at an early stage in the planting process before the plant is in the soil. At the plant schools MultiPro is mounted over the seedling and thus creates a physical barrier around the stem so that the weevil cannot reach and gnaw of the bark. On the bottom side of the cylinder there are two black markings, as dotted lines, that mark where the soil level should be. The color of the MultiPro is one of its functional parts since the weevil does not like the specific white tone due to the fact that it gets exposed to predators. Furthermore it is covered in a thin layer of polyurethane that makes it slippery and thus, hard for the weevil to climb. What makes the MultiPro environmentally friendly is that after about 3-5 years it decomposes and leaves no residuary elements behind, other than soil. (Inventor, 2016; Research Assistant Asa Försökspark, 2016; Observation Asa Försökspark, 2016)

### **Other Actants**

- Cellmark is a sales, marketing, logistics and financial service company within the forest, chemical and metal industry.
- Sveaskog AB is a large actor within the forest industry with the affiliates Svenska Skogsplantor AB and MPH-skydd AB.
- Leif Lyckebeck is the founder and innovator of MultiPro. ProForestry Sweden AB is the company created by Leif Lyckebeck and its purpose is to develop MultiPro.
- Paul Pressfeldt is the managing director at Hylte Converting, which in turn is owned by Cellmark.
- Kristina Wallerts is a research assistant at Asa Försökspark and holds a doctoral degree on the large weevil.

- Swedish Chemicals Agency is a government run agency that inspects companies and their use of chemicals, it also grants dispensation.
- Phär Oskar is a former employee at Cellmark but now runs his own company consulting for Cellmark in regards of negotiating buying MultiPro.
- Venture Cup is a non-profit organization promoting innovations and business plans in order to create a business.
- FSC is non-profit organization with the purpose of promoting an environmentally adapted, socially responsible and financially strong cultivation of the world's forests.

## Four Interconnected Narratives

### From an Idea to a Business

Leif Lyckeback, the founder of MultiPro, described how the initial idea to MultiPro grew from more than just an idea and into a business opportunity:

I am a forester from the beginning and have worked within forestry for over ten years, and that way I saw an opportunity for mechanical protection, which eventually turned into MultiPro. There is more to the background as well, the industry have strived for the exclusion of chemicals since the 70s, it started with DDP and later on permethrin, both being failures. (Inventor, 2016)

What really started the process of excluding chemicals in the forest industry was a press release (Press Statement from Sveaskog, 2011) from the prior CEO of Sveaskog in 2007, which stated they would actively exclude chemicals when fighting the large weevil. The press release put pressure on companies within the forest industry to align to the environmentally friendly idea of excluding chemicals when fighting the large weevil. Leif Lyckeback explains the importance of a large actor within the forest industry leading the way:

The idea was there already from before but the true starting point for my business was due to the press release from the former CEO at Sveaskog. It allowed me to bet on my own idea, and work with relatively small risks, so that is when I created my company. (Inventor, 2016)

With a background in forestry, Leif Lyckeback knew much about the industry before starting his own business, especially the problems created by the large weevil threatening the young conifer plants. However with the all-embracing mission to innovate a mechanical protection from the large weevil, Leif Lyckeback was lacking the financial capital to do so. He instead entered and won Venture Cup along with involving ProForestry Sweden AB with a business incubator in Uppsala. Hence with the financial aid and the knowledge from the incubator settled it was time to test the product in the field, Leif Lyckeback describes the results:

When the financing was settled I also received results from the test-center showing surprisingly good results in terms of protection from the large weevil. (Inventor, 2016)

The product would appear to be far more successful than imagined when the first results came from the independent test-center (Asa Försökspark), which had tested MultiPro during one year. As the time went by, Leif Lyckeback was forced to make some limitations to the original plan of launching mechanical protection for both bare-root seedling and plants with covered roots, to merely including bare-root seedling.

I looked at some different types of plant for the Multipro, in the beginning it was supposed to effective for both bare root and covered root seedlings, and it was supposed to be produced in Vietnam. However a competing product, Coniflex entered the market and seemed effective so I had to take a step back in the covered root seedling segment and solely focus on the bare root seedlings, which still is about 80 million plants per year, in Sweden alone. (Inventor, 2016)

With a shifting focus of MultiPro and the product getting ready for a trial in the actual plant schools the support from Venture Cup and the business incubator in Uppsala was not enough. Instead Leif Lyckeback had to turn to other potential actors in his network in order to gain access to the knowledge he needed for the next step. Leif Lyckeback explains the idea:

The goal was to find a large actor within the forest industry in order to help us develop MultiPro further. This is also another reason for the focus on covered root seedlings actually, as well as producing the MultiPro mechanically, in Vietnam it was produced manually, but not by ProForestry Sweden AB. This was in 2009, and in 2011 I sold the company and left MultiPro to other actors. (Inventor, 2016)

The first chapter in the narrative about MultiPro ended with Leif Lyckeback selling the rights to all patents of MultiPro and his company, ProForestry Sweden AB to Sveaskog.

### **Analysis**

The original link is established between MultiPro and Leif Lyckeback, the innovator. However, two actants hardly represents an actor network, instead the relationship is dyadic. When more actants are enrolled and interests are aligned, a network of actors starts to emerge (Callon, 1986; 1991; Callon & Law, 1982; Law & Callon, 1988; Akrich, 1992). The process from an idea to a business entailed both human and non-human actors, e.g. MultiPro, Venture Cup, the large weevil and Leif Lyckeback. The MultiPro act as the intermediary, in the form of a technological artifact, between the innovator Leif Lyckeback and Venture Cup, thus the link between Leif Lyckeback and Venture Cup is created through MultiPro. This in turn led to a relation between

MultiPro and the business incubator in Uppsala. Even though the focus is primarily on MultiPro it is worth mentioning the press release as an intermediary as well since it established the link between Leif Lyckeback and Sveaskog, allowing for Leif Lyckeback to move forward with his idea. According to Callon (1991) the collective action is what represents an actor network, and in the case of MultiPro and the creation of an actor network, it can be represented by the collective action in developing MultiPro into something more than an idea. However, some actants are harder to enroll and predict than others. The large weevil would be the hardest actant to predict and enroll due to its random behavior, thus acting its part as the antagonist. Meanwhile Venture Cup as an actant became aligned with MultiPro when they invested in Leif Lyckeback's business. This is in line with Callon's (1991) argument that alignment does not necessarily imply actors having the same interest, rather it aims on explaining how heterogeneous actants work together. For example MultiPro as an actant and the incubator as an actant work together in collective action, however their goals does not necessarily have to be equal. All in all it seems as if the reason for using MultiPro as an intermediary actant was to secure knowledge and financial capital so that the future of the MultiPro would be less uncertain.

Identity is something fluid and not a static state of being (Callon 1986). What we can see in the initial development phase is that what MultiPro is, was renegotiated drastically, as more actants joined the emerging actor network. First it was supposed to be used for several types of conifer plants but as a competing product, Coniflex, entered as an actant the identity of MultiPro had to be renegotiated. Secondly, it was supposed to be produced manually in Vietnam, but instead it ended up being produced mechanically in Sweden. It is these negotiations between the actants that determine their identities and the identity of MultiPro is very fluid at this point in the story since it is constantly renegotiated with each actant enrolled in the actor network (Callon, 1986; Nicolini 2009). It is in no way near being black boxed.

### **Passing the Test**

Asa Försökspark was founded around 25 years ago, it is an institute owned by the Swedish University of Agricultural Sciences (SLU). The main areas of research are environmental effects on forests and grounds but several other important projects such as research on the large weevil are active at the center. Furthermore scientific tests are conducted as well as grounds prepared to demonstrate what happens in the field in an educational manner. Kristina Wallerts has a doctoral degree on the large weevil and has the responsibility for all tests concerning the MultiPro and similar projects. She holds the position of research assistant at SLU. Kristina tries to remember how Asa Försökspark came in contact with MultiPro for the first time:

Well the research center started 25 years ago, but at that time MultiPro did not exist. I cannot remember exactly when, you will have to look into the records to see that... (Researcher ASA, 2016)

According to the reports MultiPro appears in the tests for the first time in 2006 and was at that time called IPP instead (Härlin & Eriksson, 2009). Kristina emphasizes

that the product has undergone a development over the years since the first tests were done:

What was called MultiPro 10 years ago is not the same thing as it is today. At early stages it had a paraffin coating and red markings to show at what level the soil should be. (Researcher ASA, 2016)

The founder Leif elaborates further on some of the changes that happened to MultiPro:

Over the years it has changed considerably, from the beginning it was aimed at protecting both bare root as well as covered root seedlings. But a competing product, Coniflex, for covered root seedlings entered the market and proved effective, so we had to take a step back in that area.

Furthermore the color has changed over the years as well, the specific white coating that it has today, and that is a central functional component for MultiPro have at times been brown. (Härilin & Eriksson, 2010) The relations between MultiPro and ASA Försökspark started with Leif. When Kristina is asked to describe his role she stated that:

(...) he was here often and was very enthusiastic over MultiPro.  
(Researcher ASA, 2016)

Leif emphasized the importance of Asa Försökspark being an independent test facility

(...) they do independent tests, on many different mechanical protection devices. (Inventor, 2016)

The tests conducted at Asa Försökspark are independent from any other organization than SLU and the tests are done in a scientific manner. The test period is three years, and when the seedlings are planted it is done in three separate clear felled areas and in total there are 50 seedlings in each test. The ground is either not prepared at all, or in two different ways: in a neat row or in mounds where the earth is turned up-side down. This is important since this in itself provides protection from the weevil. The parameters that Asa Försökspark measures when doing the tests are: (1) the height of the seedling (how much it grows). (2) How much of the bark is eaten and what type of damage has this done to the seedling. The type of damage is important, the damage percent may be 30 %, but if it is spread out evenly over the seedling, in spots, it does not present any danger. However, the percentage might be only 5%, but if it is concentrated to one area and the bark is gnawed off in a circle around the seedling, it is most likely that the seedling will die. (3) The condition of the actual mechanical protection device and (4) other sources of damage e.g. the plant stand in water, frost or other animals. The parameters are measured during the autumn, after the weevil season is over and is done annually for three years. (Härilin & Eriksson, 2009; 2010; 2011; 2012 2013; 2014; 2015) Kristina Wallerts described the tests:



After three years you have everything. After two years you have fairly good knowledge but just to be sure and be able to say that this is how it is you should have three years. And, you need to have this in several places as well, so it takes time. Of course you can do all the tests in a lab as well, but it is never truly the same thing as when it is done out in the field. (Researcher ASA, 2016)

This is something that Paul Pressfeldt also emphasizes,

These tests take quite some time. So it is not easy just to take over and create a cheaper product, which we in theory could do and that would work just fine. However, since we have these types of demands, it takes time. There is an accelerated process that takes about 4 months, but it is the real fields tests that are relevant, with rain and wind, it is worth more. (Plant Manager, 2016)

### **Analysis**

The tests provide actants interested in MultiPro, as well as other devices, with reliable data regarding how effective their devices are and is used as benchmarking mechanisms. As is evident from the excerpts above the independent tests are a major factor or an important actant in the development of MultiPro and how effective it is in playing its role as protagonist against the large weevil. This is emphasized by several different actants in the network i.e. Leif Lyckeback, Kristina Wallerts and Paul Pressfeldt. The tests are important in order to get the legitimacy needed for such a product, much due to them being independent of any company. Having proof on paper that MultiPro actually is working legitimizes the use in the field. This in turn amplifies the actor network evolving around MultiPro and giving it a measure of dignity, which boosts the emergence of the actor network and the actants who believe in it. Thus in its process to become an actor network, it becomes slightly more convergent and stable (Callon, 1991). Moreover the enrollment devices that MultiPro use is further strengthened (Rose & Miller, 2010) with this type of proof.

In fact, these tests are so important that they are argued to be an obligatory point of passage (Callon 1986; Law & Callon, 1988). Thus it is a needle eye that MultiPro must pass through in order to become viable product on the market. Furthermore, regardless of which way MultiPro would travel this is a point that must be passed, the same goes for potential substitutes or similar products and competitors. The obligatory point of passage is a deal breaker (Callon, 1986). If the tests would prove negative there would be no relation between MultiPro and other actants and hence, the process of developing an actor network would come to a halt. This puts ASA Försökspark as a central actant in the actor network with much influence on the identity of MultiPro. Asking the question what if the test had proved that MultiPro was a hopeless case instead clearly points to the power that ASA Försökspark posses. Such a result would force the whole actor network to renegotiate the identity of MultiPro, and possibly the death of MultiPro and the actor network.

### **The decree of fate – Hylte Converting and Leif Lyckeback**

The decree of fate led Leif Lyckeback to Paul Pressfeldt, which in turn influenced the outcome of MultiPro. Hylte Converting, being an affiliate to Cellmark, had the necessary knowledge and contacts that Leif did not have. Paul Pressfeldt describes their initial meetings:

Already eight years ago Leif was looking into something with paper and for some reason we came in contact, I do not remember exactly how but somehow we did. It was built on that we created some different ideas for what type of paper that would work with the MultiPro. Then, about five or six years ago we met again, at one of our customer's facility. That customer used a specific type of paper that Leif was testing. When it came to the production part, it was clear that he did not know what to do, so I told him that when the product is ready for manufacturing, I would like to take care of that. (Plant Manager, 2016)

The interest in the production was not just from Paul Pressfeldt's part, and Leif contacted Paul when it was time. They decided that Paul should help more than with just the production, in fact it was decided that Paul and Hylte Converting should help acquire the raw material (paper) as well. Since Hylte Converting's core business is re-rolling large sockets and cylinders of paper they have the knowledge about the material and the contacts to access it, as well as the possibility to design a machine. Leif describes the first encounter as follows:

In line with finding potential actors producing MultiPro domestically I came in contact with Paul Pressfeldt. We were both interested in the large weevil, however we did not know each other at that time. I had never met him before this encounter. Our first encounter took place at an exhibition and from there discussions led to solutions in the development of MultiPro. (Inventor, 2016)

Another motive behind this joint interest, other than that Paul had access to the necessary know how, is Sveaskog. Prior to the selling of his business to Sveaskog, Leif Lyckeback had planned to produce MultiPro in Vietnam. However, in the process of Sveaskog acquiring ProForestry Sweden AB they demanded production to be based domestically, which was also Leif Lyckebacks's final mission before Sveaskog could finalize the purchase of his business.

Cellmark, which is the company that owns Hylte Converting since several years back supports Paul and Leif's cooperation. The CFO of Cellmark describes it like this:

It is thanks to Paul that we have this business with MultiPro. And the machine that he got a hold of is great; it works with very little maintenance and with barely any personnel costs. So it is a really good thing, but we are missing the larger volumes. It is funny because this little paper socket seems as the simplest thing in the world, but really there is a lot of research and development behind it, more than you would believe. (CFO Cellmark, 2016)

The machine is today up and running. Phär Oskar is a former employee at Cellmark and works as a consultant on the MultiPro business case. He is responsible for the ongoing negotiations and describes committed volumes that Sveaskog has bound them selves to buy from Hylte Converting and the potential of the machine:

The optimal for the machine would be to produce around 8-12 million sockets on an annual basis and that would require one person working full time operating the machine. However the deal we currently have with Sveaskog is that they commit to somewhere around 4 million sockets a year. (Consultant, 2016)

With the domestic manufacturer settled, Leif Lyckeback now resigned all interest in terms of business responsibilities. ProForestry Sweden AB was sold to Sveaskog, and they created a new company called MPH-skydd which own all the rights and patents to MultiPro.

### **Analysis**

The actor network continues to expand and enroll more actors. Again MultiPro is acts as an intermediary (Callon, 1991) and when it passes between Leif Lyckeback and Paul Pressfeldt they find a mutual interest. Perhaps it is not the end product itself that is the mutual interest but what Hylte Converting can gain from producing it in terms of profit, still it is towards a common goal of developing MultiPro. An interesting fact here is that this is a “chance encounter”, before the actors meet there is no intention of enrolling each other, it is born with the chance encounter. Another approach could be seeing the large weevil, independent in terms of enrollment of all parties and having its biological agenda to follow where MultiPro could be seen as an obstacle in its natural path, or as an anti-program (Czarniawska & Hernes, 2005). The large weevil would be somewhat reluctant to engage in enrollment or translation processes, instead it is the role of surrounding actants to the large weevils whose purpose is to stabilize the actor network surrounding it. It does not necessarily need to enroll or be translated into a specific setting to, as Latour (1987) explains, stabilize the network surrounding it, but it does have an effect in regards of identity (Callon, 1986).

Drawing back to the actor network of MultiPro which is becoming more heterogeneous as different actants are enrolled. It is the effort to enroll and translation processes in the actor network that stabilizes and thereby aligning interests among actors, promoting collective action (Callon, 1991). The link between MultiPro and Cellmark also involves an intermediary, however this time it is Paul Pressfeldt instead of MultiPro that creates the link between the two. The same thing happen when it comes to raw material that is needed as well as the designing of the machine that is to produce MultiPro.

As the actor network grows it also becomes more convergent, not to say that it is in any way stable. However as Rose & Miller (2010) argues the enrollment devices becomes more powerful when they are materialized. This happens in this step, a machine is created and Sveaskog commits to buy a certain volume of MultiPro. Hence the actor network becomes more convergent based on three factors, (1) the

machine since it is materialized, (2) the obligations, and (3) the fact that more actants have been enrolled and thus, are promoting collective action. This also portrays MultiPro as a rather powerful actant in the network since it is able to mobilize other actants and possibly other actor networks around it in mutual interests towards aligned goals. Thereby MultiPro is establishing itself as a more powerful actor network and the identity also becomes firmer.

### **MultiPro at a Crossroad**

The previous accounts have traced back and described the journey that MultiPro has undertaken. This section, will instead focus on where MultiPro is currently and what is going in its near vicinity. Cellmark is interested in acquiring MPH-skydd, or at least the right to market and sell MultiPro. Hylte Converting is today producing MultiPro but in order to fully own the rights to the product, a deal needs to be struck with Sveaskog. The managing director at Hylte Converting expresses the situation as follows:

We do not own the product. So we cannot do it, it is not our product, until we have bought the business and the product. Sveaskog are full owners of the product, including the patent and all the rights to sell and distribute it. (Plant Manager, 2016)

MPH-skydd is a daughter company created and fully owned by Sveaskog and MPH-skydd takes care of everything related to MultiPro. Sveaskog is currently trying to streamline themselves and rearrange their focus to their core business of which MultiPro is not a part according to the consultant working with MultiPro. The setting for a smooth negotiation, and a deal might seem to be good at first, however there are contradictions between the parties. Phär Oskar outlines the current situation:

We have a hard time agreeing what MPH-skydd is worth. We base our evaluation on how much we can make based on how many MultiPro we can sell back to Sveaskog in the coming two or three years. Selling this product to other than Sveaskog is going to take time. (...) You have to convince foresters that they should change the methods that they have used for 25 years, which is not easy. (...) To be honest we are not that far from each other in terms of a deal, but both parties have to give and take and now we feel that they do not want to meet halfway. (Consultant, 2016)

Johan Rafstedt about a possible deal between Cellmark and Sveaskog:

They have a product that is not commercially viable before you have found customers. They (Sveaskog) do not have the time to do that and need someone else to do, so they need to get rid of this problem, and we can do this for them. If they are willing to sell at a good price. (CFO Cellmark, 2016)

The negotiation situation is tricky, much due to the different approaches that the two parties have. However that there is market potential is something that many parties independently of each other agree on. Gunnar Isacson at Skogsstyrelsen stated:

I can imagine that there is a long way between an idea to an actual product and to sell this commercially to make this profitably. There is a large economical issue, if the situation is thought about more thoroughly. I believe this to be the largest issue. There is however a great demand and the legal aspects are promoting this mechanical alternative. (...) In the meantime, actors and plant schools are waiting for commercialized mechanical products, which unfortunately, are not fully developed yet. (Ecologist, 2016)

Regardless of negotiating with different parties with hopes of acquiring MPH-skydd and not making any noticeable progress, Phär Oskar still have similar opinions as Gunnar Isacsson on mechanical protection:

I believe that this product has potential. If it does not happen under the direction of Cellmark, that Sveaskog does not want to sell MPH-skydd to Cellmark, then they will either continue on their own, or they will find someone else to do it with. (Consultant, 2016)

The company MPH-skydd and its product MultiPro is specialized to protect bare root seedlings, Hans Thyr at Sveaskog regarding the specialization and future of MultiPro:

The bare root seedlings is a rather uncertain market where many new actors emerge almost every day. The MultiPro is not as strong actor on the market as our other product Coniflex, being a market-leading product at the moment. Hence, the future of MultiPro is hard to speculate about since the market is uncertain and many new innovations are yet to be presented to the market. (Market Specialist, Sveaskog, 2016)

The organizations within the forest industry working on mechanical protections are not keen on sharing innovations. There is little cooperation going on between organizations when it comes to mechanical protection, instead they work rather independently of each other. Johan Jonsson about the market potential:

The policy here is that we are to stop using chemical protection by 2019, and there is a concrete action plan for that. The goal is to use our own mechanical protection, which we started to develop 2010. (...) We are not alone on the market regarding mechanical protection, everyone that wants to be certified by the FSC must work towards excluding chemicals in the forest industry, and there is international interest from Germany and England as well. (Manager, Södra Skogsplantor, 2016)

Södra Skogsägarna has developed a type of wax that covers the plant so that the large weevil cannot gnaw away on the bark. However, the manager at Södra Skogsplantor expresses that there are problem with their product:

The biggest problem that we face is the costs for using the product. In Sweden there is a clear focus on the environmental aspects, it is not the same on an international level. (Manager, Södra Skogsplantor, 2016)

A situation that binds the competitor to MultiPro is the fact that Kemikalieinspektionen cannot stop granting dispensations for the use of chemicals until there are viable options. The managing director of Hylte Converting regarding the temporary dispensations:

They have (the dispensations) been used for a really long time today, so there is an exception that has become a rule, more or less. But some of the chemicals are on their way out but that requires that there are alternative methods to chemicals. Kemikalieinspektionen cannot place the whole forest industry in a situation where there is no protection, and there cannot be only one alternative. Then we end up with a monopoly, which cannot happen. (Plant Manager, 2016)

### **Analysis**

The being or not being of a need for other protection than chemical does not seem to be in question by any of the actants. The ongoing negotiation between Sveaskog and Cellmark has a potential impact on MultiPro, however the existence of MultiPro as an actant does not depend on this deal going through. This negotiation is instead a waypoint for the MultiPro, if Cellmark acquire the rights to market and distribute MultiPro, then the actor network becomes more stable and convergent, through obligations (Callon, 1991; Rose & Miller, 2010). Obligations between the companies in the close future since the deal would entail Sveaskog committing to buying certain volumes. It would also present a key to creating a larger actor network, by allowing Cellmark the selling and distributing rights, and thus making Cellmark an actant involved in the enrolling of other potential actants into the MultiPro actor network. That is something that Sveaskog has neither the will nor the time to do on their own. If a deal is not reached between Cellmark and Sveaskog, the actor network will have to reconfigure itself around MultiPro and identities will need to be reconstructed as well as renegotiated. The relation between Cellmark and MultiPro would then end and the actor network would become more divergent (Callon, 1991).

A couple of actants that have the possibility to strengthen or weaken the MultiPro network is Kemikalieinspektionen and FSC. If they would go out and recommend MultiPro as a viable substitute to chemicals, it would give the MultiPro as an actor network a stronger identity. Conversely, if they would go out and recommend the Coniflex instead, the identity of MultiPro would have to be renegotiated with a potentially negative outcome in terms of actor network convergence. Thus Kemikalieinspektionen could be seen as an anti program, or as the opposite (Czarniawska & Hernes, 2005). Competing products also have their emerging actor networks and ironically these two more or less separate networks are bound together through mutual need of a competitor as well as by the large weevil.

Even though MultiPro as a product is developed and has a documented good effect the development phase is not over since it is not fully launched and cannot be considered as a commercial success yet. MultiPro must still tie some sort of marketing expertise and infrastructure for larger sales volumes to the actor network in order to be commercially successful, this is where Cellmark is a possible actant.

Hence, a deal between Sveaskog and Cellmark would incorporate such knowledge and skill into the network and manifest MultiPro as an even stronger actor.

## **Discussion**

Drawing on main findings from the analysis, it can be seen that an actor network has evolved and gradually established itself around MultiPro. It has gradually become more convergent striving towards a common goal of getting MultiPro on the market. The growing of the actor network is in turn based on the enrollment of actants through the use of intermediaries. At times MultiPro has acted as an intermediary and at other times MultiPro has empowered other actants to act as intermediaries. Over the years that the actor network has developed, MultiPro has proven itself to be a powerful actant in the network by enrolling others and strengthen its identity continuously. MultiPro has continuously developed during the years due to its actor network growing, in the process of enrolling actants to actor network. However, the actor network is in no way near to being black boxed, it is still developing itself and the results are yet to be seen. There are several factors that were important in the actor network during the innovation or product development phase and the discussion that follows will focus on five obligatory points of passage: (1) an opportunity and incentive, (2) financial means, (3) rules and regulations, (4) knowledge and know how about manufacturing and (5) knowledge of marketing, sales and distribution. It is important to understand that innovation and product development is a dynamic process as portrayed in the narrative. The obligatory points of passage are not given points in a sequential sense. Instead they are interconnected and do not necessarily need to be heeded in the stated order. The dynamic process of innovating seems to entail all five obligatory points of passage in developing a new product and the actor network connected to that innovation. However, these are not standardized tools for innovation or product development.

### **Opportunity and Incentive**

Having an idea of an innovation or a new product development is not enough, there need to be a business opportunity and some kind of incentive as well. In the case of MultiPro that opportunity arose with the press release that reduced the risk, even more importantly being a small enterprise, as well as showing that there was a demand for such a product. Furthermore, this together with chemicals gradually being phased out in the forest industry created an opportunity. Thus, this also presented an incentive to reach out and create an actor network since a small company needs to acquire means that does not currently reside within the actor network boundaries, which at the time is equated to the boundaries in terms of MultiPro.

### **Financial Means**

SMEs and micro firms often lack the necessary resources in financial terms to sustain a long and costly product development phase, especially taking in the risk of failure. The development phase can be long a tedious, as the case with MultiPro where

incremental innovation requires financial means over an extended period of time. That does not necessarily present a problem, as long as the financial resources can be tied to the actor network by enrolling them, it does not matter whether it is located within the organizational boundaries as long as it can be accessed through the actor network. The actor network evolving around MultiPro did this by several means e.g. enrolling Venture Cup and selling the rights to Sveaskog.

### **Rules and Regulations**

Spending resources on innovation and product development is futile if it does not heed laws and legislations as well as industrial standards. If MultiPro would not be in line with e.g. Kemikalieinspektionen guidelines, it would never have been considered to be further developed. Industrial standards are equally important, in the case of MultiPro both Asa Försökspark and FSC play important roles. Legitimacy can never be acquired if these types of standards are ignored in the development phase. An organization independent of its size cannot do this on its own, other actants in the actor network that contribute with such factors becomes important. As an obligatory point of passage it might seem obvious, but due to its importance it cannot be excluded.

### **Knowledge of Manufacturing**

An idea and business plan will never succeed unless the product can be manufactured in an efficient way. Again this is something that MultiPro tied to the actor network when it was needed. Even though the actor network had grown and incorporated financial means, the actor network had no knowledge of that type of manufacturing. Instead that was added to the actor network with Hylte Converting and Paul Pressfeldt.

### **Sales, Marketing and Supporting Infrastructure**

The ultimate goal of a company is often to survive and make money, sales, marketing and the supporting infrastructure will ultimately be the final obligatory point of passage in order to profit from the opportunity. The knowledge and infrastructure to support a product launch, and how to manage sales and distribution is important. This may or may not be provided to MultiPro through the possible deal between Sveaskog and Cellmark. These are all critical parts in an innovation or product development process if the product is to be successful. If one of these actor network connections is missing or cannot be established, then the product is doomed to fail.

### **Innovation as an Interconnected Process**

The obligatory points of passage, which have been identified in the context of the forest industry, might indeed have a generic value beyond this specific context. What they particularly point at is a processual and external approach on innovation and product development. These obligatory points of passage are not exact points but rather pieces in an interconnected innovation process. Moreover, they do not need to be in the exact order or sequence presented here but they are all interconnected in the



development process. For example the interconnection can be conceptualized by scrutinizing the relations between *one* of the obligatory points of passage and the other four: an organization will never manufacture something without the knowledge, or if it in any way break any rules and regulations, or if there is no incentive or opportunity to do so, or if there is no sales or marketing strategy, or if there are no financial investments made. Furthermore, the obligatory points of passage are not necessarily sequential, they might play more or less important roles at different points in time during the innovation process.

There are few companies that can handle the obligatory points of passage on their own within their organizational borders. However, most organizations can pass through them by creating links to actants that has the “know how” or skill in an open innovation process (Gassmann, 2006). Consequently these obligatory points of passages strengthen the links between actants and/or actors and promote collective action so that these points may be overcome. Therefore focusing on what perks or shortcomings and certain organization has dependent on what size they are or in what industry they operate (Millward & Lewis, 2006; Hadjimanolis, 1999; Kaufmann and Tödtling, 2002; Nicholas, Ledwith & Perks, 2011; de Jong & Marsili, 2006; Hoffman et al., 1998) is missing an important point, the fact that innovation is a much more dynamic and a less static process. The previous research has been focused mostly on the internal abilities that an organization has, however organizations are not operating in isolation but in constant contact with the external environment. Much of the existing research on innovation and product development is focused on either sector level or on firm size level (de Jong & Marsili, 2006) and thus on the internal abilities (Hoffman et al., 1998). When instead the product itself is the subject of research it can be seen that it passes through all of the different firm sizes and through several industries, thus drawing on all “perks” independent of size or industry. Furthermore some of the shortcomings such as lack of external contact instead become a strength that forces the actor network to enroll other actants during the innovation process. Besides active enrollment, chance encounters can play an important role in who or what gets enrolled in the actor network. Often enrollment involves active negotiations, however these can come to be by a simple chance encounter, as happened between Leif Lyckeback and Paul Pressfeldt. A product might begin its journey with being innovated by a micro firm, which then receives financial support from an investor, knowledge about patents from a third actor, knowledge about manufacturing, sales and marketing from a fourth or fifth actor and so forth. Hence, the actor network behind the innovation is seemingly more important to study and understand than the taxonomies based on size, key attributes, internal abilities and structures.

Focusing on enrollment in the innovation process puts the innovation or the new product in a central position to find and enroll other actants that have a good fit for the emerging actor network. Thus having powerful interessement devices at hand is crucial for an innovation process, since it can alter the speed and efficiency of it. Acknowledging interessement and enrollment as an active process add yet another

layer of dynamism and moves innovation farther away from the previous static approach.

Seeing the five obligatory points of passage and the process that it entails is one viable option for understanding how an innovation becomes reality. However, they alone will not suffice in the process of developing and launching an innovation or a new product. Instead, the importance of actants and actors that are able to create interessement and enroll other actants in order to grow the actor network have been highlighted in the case presented in this study. Hence, the actor network could actively seek to enroll new members and thus, grow the actor network in order to obtain the resources and knowledge to pass through these five obligatory points of passage. The collective action (Callon, 1991) of the actor network is what can innovate and develop new products and launch them.

## **Conclusion, Limitations and Implications**

We believe that the approach that we have undertaken paints a more dynamic picture of innovation and product development than focusing on the organizational size or on one single entity. Instead refocusing the scope to a wider width can benefit the discourse by showing that products and innovation often travels between and through several entities in order to become reality, they do not reside within one company. Thus there is no reason to focus on individual companies, the whole actor network is behind the innovation and the focus should be on the innovation process, which is not necessarily bound to specific organizations. Key aspects in the innovation process that has previously been neglected is the enrollment and the interessement devices and what central role they play in the emergence of an actor network. The five obligatory points of passage act as guidance for the actor network to identify and enroll actants that will add value to the actor network and the innovation process. Practitioners can benefit from such an approach that ignores the organizational boundaries and instead focuses on the actor network, its emergence and thus, focus on developing it and thereby also the innovation. As for researchers we hope that the approach that has been undertaken in this article helps the academia understand the importance of dynamism and the role that enrollment plays in an open innovation process.

In regards of the actor network, we realize that it might seem narrow since it in reality stretches beyond the actants that are portrayed here, and we do not claim to have mapped the complete actor network. However we have shown how the actor network developed. This is partly due to the scope of the article and the spatial limitations that the guidelines provided. Another limitation is that we have relatively few interviews, these have however been complemented by observation and document analysis in order to present a thick narrative. Furthermore the actor network determines the number of interviews and we did reach a saturated state. This investigation was carried out in a slow paced industry with few large actors that tend to focus on their own. MultiPro as an innovation has at times been a competing product, which has made potential interviewees reluctant to agree to an interview. Lastly, we as researchers started out with a partly glorified idea of what MultiPro is

and what it could become, this due to the first interview being with Cellmark and them having the goal of selling the product. However, during the process we have acquired a more nuanced idea of what the innovation is and what influence the actor network has on it.

Future research could be directed at examining if the five obligatory points of passage change in any way if they are applied to cross sector innovation networks. Clusters is another interesting point to investigate, perhaps the innovation process can be “hurried” since a cluster presumably entails many of the five obligatory points of passage in their innovation network already. A third stream of research that would be interesting is the role of chance encounters in the innovation process, to what extent is their role important?

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# Appendix A

