



MANAGING THE PARADOX OF EARLY PRODUCTION INVOLVEMENT AND INNOVATIVENESS - TO INVOLVE OR EVOLVE, IS THAT THE QUESTION?

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1. Introduction

It is now a well-established fact that innovation is important for a company's competitiveness and long-term development. The realization of new and innovative products often also requires a corresponding development of the company's production process. The introduction of new products might, however, disrupt production and reduce productivity [Roper et al. 2008]. Hence, there is a need to bridge and strengthen the interface between R&D and production – i.e. those developing the product and those who will realize it [Legardeur et al. 2010], [Storm et al. 2013] to avoid delays in market entries [Brettel et al. 2011].

However, the more developed and refined a company's production process is, the more difficult changes and selective improvements in the process become [Utterback and Abernathy 1975]. In established companies, it is therefore not uncommon that production is seen as a conservative force that promotes the use of already existing practices and equipment. Cross-functional teams and early involvement of production is therefore likely to introduce promoters of more routine-based solutions and increase complexity by introducing more team members and more perspectives [Swink 1999]. For companies to become successful in their quest for innovation and efficiency, there is a need to understand interactions between R&D and production, which unfortunately is not always the case [Smulders et al. 2003].

Integration, between R&D and production, and the interaction it entails can therefore be seen as a double edged sword, a paradox, as it is both a prerequisite and an obstacle for innovation. Kurkkio et al. [2011] show that this paradox stems from the fact that early involvement of production can be an important tactic to increase the speed and quality of the development process (because the transition from development to production runs more smoothly as knowledge is integrated early on and resistance to change is reduced). However, integration and early involvement from production can result in low innovativeness because it favours incremental adjustments of existing operations and processes at the expense of those more radical [Swink 1999], [Kurkkio et al. 2011]. The paradox between early production involvement and innovativeness is not new, and there is a longstanding discourse in the scholarly literature that relates to it. Still, the paradox has not been resolved and further research is needed to understand how the paradox can be managed, particularly by team members involved in innovative efforts. This paper aims to add to our understanding of how this paradox of early involvement from production and innovativeness is managed by R&D teams. Inspired by the famous quote from Shakespeare, we ask: involving production or evolving an innovative offer, is that the question?

Purposive sampling of projects awarded for their innovativeness was used on the basis that the paradox in question is believed to be more prevalent in innovative projects than more routine projects. This sampling procedure enabled the company perspective to be used for judging the innovativeness of the projects. In this study, innovation is defined as products with great customer benefit and commercial value that has resulted in either performance enhancements, efficiency improvements or the creation of new markets [Christensen and van Bever 2014].

2. Theoretical frame

To further understand the paradox between early production involvement and innovation, it is necessary to understand that innovation can take many forms – just as the journey to get there can differ. Also, the division of labour between R&D and Production, from a historical perspective, and the interface between them are further described in this exposition of the literature. Finally, the research objective, including a specific research question, is stated.

2.1 Innovation outcomes and the journey to get there

Innovations are often differentiated by the magnitude of change they bring about - often with words like incremental, evolutionary and revolutionary [Jacoby and Rodriguez 2007] or radical [Gopalakrishnan and Damanpour 1997]. Another way of categorizing innovation is based on the impact on growth. According to this categorization performance-enhancing innovations substitute old products with new and better models, efficiency innovations help businesses manufacture and sell products or services at lower prices, while market-creating innovations transform products in such a way that they create a new class of consumers or even new markets [Christensen and van Bever 2014]. Performance-enhancing innovations are closely linked to changes in the product, whereas efficiency innovations are based on changes in the process to a higher degree. Yet, these linkages do not tell the whole story. Just as changes in product design can lead to major improvements in the production process (e.g. [Walsh and Roy 1985], [Carlile 2002]), changes in the production process can help create new products (e.g. [Becheikh et al. 2006]). For manufacturing, the link between product and process innovation is an important issue [Linton and Walsh 2008], and thus important that theories of innovation account for the interaction between product and process innovation [Reichstein and Salter 2006]. Legardeur et al. [2010] highlight this when they argue that innovation cannot win in a single dimension, i.e. one dimension cannot exist alone. Consequently, studies of innovation need to account not only for the type of innovation studied, but also consider links and interactions between product and process innovation in a holistic manner.

2.2 Division of R&D and Production – a historical backdrop

The division of R&D and production can be traced back to at least the late-19th century and the emergence of mass-production models founded in scientific management [Bessant and Caffyn 1997]. At this point in time, new development was made by specialists who often worked independently from regular operations. In large part, this separation of the ‘head’ and the ‘hand’ was the dominant approach for much of the 20th century [ibid.]. One reason for the decoupling of sub-processes from each other, e.g. R&D and production, is that it allows better management and assessment of risk levels in each process. Moreover, when there is a high degree of technological novelty, a modular design as well as a sequential process (as opposed to overlapping phases) can provide the necessary peace of mind for involved parties [Lakemond et al. 2007].

However, a consequence of the separation between sub-processes was that the development process became known as an over-the-wall process or a relay race [Ullman 2003]. During the 1980s and 1990s, Concurrent Engineering was introduced to facilitate for companies to take timely, informed decisions, enable reduction of the total lead time, and avoid late and hence costly changes [Hartley 1992], [Prasad 1996]. Integrated Product Development put an even stronger focus on cross-functional teams and integration of organizational functions, such as marketing, design and production [Isaksson et al. 2009]. Integrated Product Development highlights that tasks should be carried out in a simultaneous or parallel iterative process and therefore support the overlap and integration between activities and focus on good communication [Gerwin and Barrowman 2002]. By integrating those who develop the product with those who will materialize it, coordination and the ability to plan for production are likely improved.

However, there is also a risk that new ideas and solutions will be disregarded early in the process based on their difficulty to manufacture. In this case, integration and early involvement from production can result in a conservative mind-set that favours incremental adjustments at the expense of innovativeness [Swink 1999], [Kurkkio et al. 2011]. This paradox needs to be considered to truly bridge the interface between R&D and production successfully.

2.3 Over-bridging the production and R&D interface

A foundation for achieving integration and a shared understanding of problems is increased interaction. The literature has several means and mechanisms of interaction. In their study of an un-fulfilled innovation, Legardeur et al. [2010] identified the interface actor as a key network role. The interface actor is an individual who can manage a certain amount of tension between promoters of a new system and promoters of a more routine-based system, thereby facilitating information flows. Overbridging interfaces can also be achieved when actors on one side of the interface consider, and act upon, information from the other side of the interface at early stages of the development process. Walsh and Roy [1985] showed that designers who considered issues involving marketing, production or both – not leaving them to others – distinguished successful companies from representative companies. Such a role, as an interface actor, can of course be played by non-designers; for example Nihtilä [1999] describes how a production planner acted as a liaison between R&D and production. Moreover, the effectiveness of this individual integrator, as an early integration mechanism, was identified to be positively related to a clear distinction between product development and operational activities [ibid.]. The work of an interface actor can be facilitated by something to hold, feel, look at and try out, especially in discussions with staff from other functions whose contributions are needed in early stages [Walsh and Roy 1985]. The concept of a boundary object describes objects that can be shared across different problem solving contexts, i.e. it is an object that works to establish a shared context that ‘sits in the middle’ [Carlile 2002]. As well, other terms describe objects with similar characteristics, like boundary objects have been presented, e.g. transitional objects [Nihtilä 1999] or intermediary objects [Legardeur et al. 2010]. Boundary objects play a key role when transforming knowledge from one side of an interface to the other. Objects, models, maps [Carlile 2002] and plans [Nihtilä 1999] are examples of such objects that allow individuals to alter or manipulate the content, and consequently allow the transformation of current knowledge used at the boundary.

Yet, when should this interaction actually take place? Well, research has shown that the benefit of integration differs depending on the phases of new product development (i.e. development and commercialization) and the level of innovativeness in the project (i.e. incremental or radical) [Brettel et al. 2011]. For incremental projects, manufacturing benefits from early R&D information transfer, as this enables preparations for efficient production. However, no positive effect from integration in the development stage could be observed for radical projects [ibid.]. One reason is that manufacturing personnel may not be able to provide valid and relevant information to R&D if the project is more or less radical. This agrees with the observation by Nihtilä [1999], where early involvement put the production organization into a new, proactive and more demanding role.

2.4 Research objective

Today, companies need to achieve both innovative outcomes and an efficient production process. There is, however, a paradox residing in the fact that early involvement of production both facilitates and hampers innovation [Kurkkio et al. 2011]. Early involvement of production can result in products better adapted for production, even though it favours incremental adjustments of existing operations and processes at the expense of more radical solutions [ibid.].

The aim of this research is to further understand how project teams manage this paradox of early production involvement and innovativeness. To achieve this, an interview study with project teams that have succeeded with innovation was conducted. The study was guided by the following research question: How do innovative project teams manage the paradox in early production involvement and innovativeness?

3. Research design

The present research is based on an interview study of projects awarded for their innovative output, all from the large Swedish Engineering Group. The Engineering Group has products ranging from machine tools, mining & construction equipment to advanced materials. Two internal awards for innovation exist within the Engineering Group, which were used in this study to sample projects perceived as innovative. One award is given to the product developer of the year who created a product with “great customer benefit and commercial value”, while the other award was instituted to stimulate and award innovative achievements [Karlsson and Törlind 2014]. The study was delimited to include projects that have received one or both awards from 2004-2011 and where products are still on the market. By using data from projects that have resulted in an outcome perceived as innovative, from a company perspective, it is believed the paradox of early involvement from production and innovativeness can be studied in retrospect and management strategies better understood.

3.1 Data sources and data collection

Individuals within the Engineering Group who received one or both of the awards were contacted and asked for an interview (N = 21). In total, 3 recipients did not respond to the request, which resulted in 12 interviews with 14 respondents (1 group-interview) from 8 different projects.

Semi-structured interviews were selected as the main data collection method, since interviews constitute an efficient approach for collecting rich empirical data [Eisenhart and Graebner 2007] necessary to understand complex phenomena. All interviews were based on an interview guide with open-ended questions relating to, for example, the background of the respondent, the project they were involved in, the journey from idea to innovation, as well as team composition and received help in the project. The respondents were free to elaborate when answering the questions and follow-up questions were used to encourage detailed descriptions and explanations. All interviews were performed in Swedish, recorded and transcribed; all quotes in this paper are consequently translated by the authors. Interviews were conducted and analyzed by a team of internal and external researchers. The internal brought understanding and knowledge of the specific context, official processes, internal lingo etc. to the table. The external contributed with objectivity that was utilized when analysing the material and drawing conclusions.

Table 1. descriptive information about the projects, the respondents and the interviews

Project	Position of respondent/s (No of award recipients)	Length of interviews in minutes
A: New series of milling cutters for aluminium machining	Product developer (1 of 2)	50
B: A new method for the surface treatment of steel	Business developer (1 of 2)	62
C: A new stainless material for manufacturing of artificial fertilizer	Segment manager; Project leader R&D (2 of 2)	78 ; 58
D: A new indexable insert drill	Project leader R&D; Product developer & Project leader (3 of 3)	45 ; 72 ; 60
E: A new generation of fine grained substrates	Project leader* (1 of 1)	36
F: Physical Vapour Decomposition (PVD) coatings	Project leader*; Product developer (2 of 3)	36 ; 58
E: New lead-free alloy for the watch industry	Project leader; Metallurgist; Specialist (3 of 3)**	72
G: New generation of turning tools for threading	Product developer; Product developer (2 of 2)	71 ; 81
* One recipient was awarded twice for the same development; this recipient was only interviewed once		
** Group interview with three respondents		

3.2 Data coding and analysis

To clarify the empirical data and identify recurring and dominant themes, selective coding was used. Data reduction in the form of pattern matching followed by displays of the data was utilized to draw conclusions and synthesise the findings [Miles and Huberman 1994]. Data coding and analysis consisted of the following steps:

The first step in the selective coding involved the selection of central categories. This step was informed by the preceding literature review and resulted in the following categories: The origin of interaction (e.g. R&D, production, other), Means of interaction (e.g. actor, object, other), Timing of interaction (during development, hand-over to production or commercialization) and the Outcome of the innovation. In the second step the interview transcripts were read through and all instances relating to the R&D and production interface were highlighted. In the third step the result from the previous coding was compiled in a spreadsheet with columns for the central categories and one column labelled other. During this step, how the quotes fit with the central categories were registered. Finally, pattern matching was applied within each project and also cross projects. In this step, a mind-map over identified patterns was developed for each project, which were later compared in a cross case analysis of the projects. These mind-maps led to the results presented in the Findings section of this paper.

4. Findings

In total, 131 instances relating to the interface between R&D and production were identified in the interview transcripts. Of these, the timing of interaction was discerned in 37%, the remaining instances were of more general character. Where the timing of the interaction was discerned, 53% took place during the development phase, 22% in the hand-over to production and finally 25% in the commercialization phase of the projects. The origin of the interaction could be identified in 47% of the recorded instances, of these 43% were initiated from R&D, 21% from production and 36% from other sources (customers, the market, machine suppliers, etc.). From the perspective of the respondents a vast majority of the awarded projects resulted in performance-improvements, i.e. the outcome of the projects replaced old products with new and improved projects. One performance parameter that difficult to relate to the different categories of innovation – i.e. performance-improving, efficiency or market-creating – was that the innovation was easy to grasp for customers. This parameter might not impact whether or not the product will be valuable to the customer, but it will affect how easily the customer adopts the new product.

Performance-improving innovations in some cases (as seen from the company perspective) also resulted in efficiency innovations or even entirely new possibilities when adopted by customers. What started as a performance-improving innovation in one of the projects ended up as a market-creating innovation. In this particular case, an entirely new product area was created and a new production unit established. These examples highlight that the categorization of an innovation outcome can vary depending on the applied perspective, i.e. what is seen as a performance-improving innovation from a company perspective may imply huge efficiency improvements for a customer.

4.1 So what is really world class? – the role of objectives and attitudes

Several respondents stated that vivid discussions with production took place during the projects. One respondent also wished for increased integration with production: "in fact we should sit on top of each other for this to work really well [...] it is really important to have contact so that you get to know each other" [Project D]. Another respondent, from the same project, provided more background to the situation: "we sat together all of us, product development, design, the project leader and the product owner. And then we had production [manufacturing plant at another site], which we were not co-located with, and it was one of the problems that arose later, that we could not produce as we wanted". However, it was not only R&D that required a lot from production, demands in the other direction were also common. In Project G problems in the assembling the product was revealed after the product had been launched. In that case the product developers found a way to solve the problem as well as a way to transit from the old solution to the new. Hence, that R&D and production challenge each other with tough requirements may potentially lead to improvements in the product and not only favourise incremental adjustments. However, something that should be avoided is when the demands of the

different parties result in a deadlock where no one is willing to compromise. An issue that complicates matters is when R&D and Production are measured and evaluated towards different objectives, as highlighted by one of the respondents: "He told us [the project leader], the senior managers in production stated that, well, if it was not for two products, then we would be world class here. And what is special with these products, well it is that they have another interface that is a bit more cumbersome to produce" [Project G]. Hence, from a production perspective two products were so difficult to produce that they were thought to spoil the delivery capability of the entire production site. However, these products were obviously important products for the company as a whole. When R&D is measured based on the amount of new products and patents, production is measured on the amount of products produced and their quality. These orientations clearly conflict and have resulted in different perceptions of what is 'world class'.

4.2 Boundary objects and interface actors - is that enough?

As expected several boundary objects were used in the projects. Besides more traditional boundary objects, such as time plans, CAD models, prototypes and specifications of demands, ideas were also brought up in relation to boundaries. Ideas, or representations of ideas, are therefore not only important as seeds for innovation, but also for communication purposes. One respondent, in project D, stated that "there was a lot of contact with production [...] but it was not until we had an idea, well you have to have something to analyse, you have to have something to juggle back and forth". Ideas seemed to help this respondent, as they provided some kind of focal point for the early interaction across the R&D and production interface.

When interface actors were introduced into the interviews, two backdrops were commonly mentioned: 1) that the actor had changed jobs, or 2) organizational belonging to a prototyping function. In one project, it was particularly evident how changing jobs created interface actors. In this project, one of the principal product developers had previous experience from production and contributed very much in that respect. The other principal product developer actually changed jobs during the course of the project, and began working in one of the major market areas: "When I moved, the development work was basically completed while production adjustments remained [...] I continued to work with this [product] out in the market, preparing market introduction. By doing so, we actually learned a couple of new things that we were able to bring back and actually change [to improve functionality]" [Project A]. Not only the experience from previous work (in other areas), but also the individual's social network means individuals becoming interface actors. The other influential backdrop related to a special organizational affiliation. One respondent from project A described how they used a production engineer, who manufactures prototypes, as the reference person for producibility/production related issues in the project. This was the case even though a production engineer from the regular production was also part of the project team. In another project the production engineer from the prototyping function went even further, as described by one of the product developers: "he began to familiarize with the production technology, and discovered things that we needed to consider. So what he has done is written a document for [the regular] production, describing how to produce and what to think of" [Project G]. The same respondent explained that prototypes can be used as a lever in the interaction with production, as a proof of concept showing that it really can be done. These examples indicate that a prototyping function can be seen as an interface function, i.e. a function that enables communication and acts as a 'buffer' or 'shock absorber' between R&D and production.

However, the respondents not only brought up objects and actors as important for the interaction, but examples of channels for interaction, such as e-mail conversations, conferences, problem solving meetings and reference groups. One respondent stated: "In the projects, we have reference groups [they help to clarify whether], is it good or bad? [...] the group can include people from sales, people with technical expertise, from production or from the research organization". Integrations channels appear to help with the question of how the interaction can take place, complementing objects (what) and actors (who) that are involved in the interaction.

4.3 Coping with the paradox - strategies of separation

The projects also exhibited a flora of strategies to deal with the paradox of early involvement from production and innovativeness, all of which featured some kind of separation. The different separation strategies became apparent in the cross case analysis of the projects, where mind-maps of identified patterns for each project were compared. The identified strategies of separation, listed and exemplified below, contributed towards how project teams and team members manage the paradoxical question of involving production or evolving an innovative offer:

- **Separate function:** Prototyping served, as previously mentioned, as a 'buffer' or 'shock absorber' between R&D and production. A separate function in the interface between R&D and production helps to translate across the interface, and challenge both R&D and production. By stating, and showing, that 'the sky is the limit', the prototyping function helps R&D engineers and Production engineers to raise their game. A separate prototyping function also provides a common and perhaps more neutral ground for dialogue between R&D and Production.
- **Separation in time:** In one project (Project G), it was evident that R&D engineers deliberately thought of innovativeness and producibility in a sequential manner: "I hadn't thought of it so much [production issues], to me it seemed to work. Like I said, if you listen too much to production, then you might not even try. Sometimes it is better to just do". The same respondent continued that later in the project: "you had to turn every stone to see it from a production standpoint". This separation strategy, used by individuals who otherwise work in cross-functional teams, seemed to create the necessary peace of mind to think of innovative solutions.
- **Separate equipment:** In project F the separation strategy applied to the production equipment. In this case, it was feasible to put a full scale production machine at the R&D site, which enabled the R&D engineers to receive more from the equipment than what was expected. This strategy also had implications for the hand-over to production: "The machines that we have are full production scale machines. So the things that we have been able to perform down here in the lab, we were able to transfer directly to production. Just buy the same machines and run the same processes, it is a great advantage". The benefits of this separation strategy are not only easy access, but also that R&D learns of how mature a solution should be for it to successfully transfer to production.
- **Separate activity:** In another project (Project C) it was not feasible to have separate production equipment within R&D, since this would mean excessive investments. Instead, in this case there was a strategy that distinguished and prioritised between R&D and production activities. One respondent stated that: When it was time to test in full production, we always had the highest priority, which was great! The approach was that the head of department signed a document, and then we had precedence in the [production] queue". Hence, activities were separated by giving them different priorities.
- **Separate individuals/teams:** Another strategy frequently used in the projects was to assign separate teams, or an assisting project manager, responsible for the manufacturing of the new product. This enabled one subset of the project development team to pay particular attention to production, with all that it entailed. However, this separation strategy might risk the loss of the holistic picture.
- **Separating introduction procedures:** A separation strategy that related to the introduction of the new product. In this case, several variants of the product were introduced in a stepwise manner. Depending on the level of uncertainty in producibility, it was possible to decide whether or not to introduce the part of the product program that sells in high volume (the bulk) or other parts in the first step. A respondent from project G states: "[Usually] one makes all the tests within the area that is the most used and sells the best [i.e. the bulk] and then when you extend the program, the knowledge is taken from there and stretched [...] However, when you are unsure of production, how it will go, then it might be better to start out in a corner [leaving the bulk for later]". This strategy enables validated learning before introducing the bulk of the product program.

5. Discussion

In today's organizations, R&D project teams have become fundamental units for generating and transferring ideas into useful technology, products or services [Chen et al. 2008]. To understand innovation as a phenomenon, it is therefore vital to study these teams at the focused level. In this study, this was attempted through the purposive sampling of projects resulting in innovations deemed to have great customer benefit and commercial value from a company perspective. Moreover, the research presented in this study has approached innovation in a holistic way, by accounting for interactions between R&D and production in an organization.

An observed obstacle to successful integration between R&D and Production was the difference in their objectives. This is an area where the paradox between early production involvement and innovativeness really becomes evident. While R&D is assessed on things like patents and the ratio of new products in the total product offer, production is evaluated on production levels and quality – things that are not necessarily conducive to novelty and change. At the same time, different objectives can create and encourage differences in perspectives, which is very beneficial when it comes to innovation [Kelly and Littman 2006]. However, this kind of specialization has also been shown to make collaboration across practices more difficult [Carlile 2002]. Because innovation cannot win in a single dimension, it should be considered by those involved in an innovative effort. Consequently, depending on the expected outcome of a product development project, management is advised to clarify which objectives are the most important in the particular case (routine vs. innovative project).

The findings also show that both functions – R&D and production – had high demands on each other, which can be beneficial to the company as a whole. This is, however, something that can be influenced by increased integration. Previous research, in an inter-organizational product development context, has shown that integration of internal functions can have unexpected and negative consequences, for example that goodwill trust for a third part is crowded out by formal control [Brattström and Richtner 2014]. Therefore, it is not farfetched to assume that integration between functions will also influence what the two functions expect from each other. One relevant question to pose is therefore whether integration between R&D and production will make it easier or more difficult to have high expectations and demands of one another?

Still, the main finding from this research was that the teams in the projects utilized strategies of separation to manage the paradox between early involvement from production and innovativeness. Previous research has shown that the de-coupling of sub-processes can be a way to handle specific degrees of risk in each sub-process, in this case R&D and production [Lakemond et.al. 2007]. In fact, modular designs or even sequential processes can provide the necessary peace of mind for those involved in the work [ibid.]. The identified separation strategies can create this peace of mind on the micro level of the organization – with the individuals involved in the project. Although the identified separation strategies seem to allow individuals and teams to handle the focal paradox in practice, little is known of how the different separation strategies gradually influence the interaction between R&D and production. For example, when the separate activity strategy is used, there is a risk that the precedence for R&D activity will undermine production in the long term. Potentially, if this strategy is misused, production might be disrupted and productivity reduced [Roper et al. 2008] to such an extent that customers will be affected. Moreover, there is still a challenge regarding what separation strategy to utilize and when, due to the particular company and context. For example, some separation strategies (separate equipment or separate function) might not be possible in some companies due to the characteristics of the production process. This area would also require further research.

One particularly interesting separation strategy concerns a separate function in the interface between R&D and production, i.e. a prototyping function. The prototyping function not only creates a common ground for R&D and production, it is also a translator between both functions. In addition, the prototyping function is an instance when engineers, from both R&D and production, can turn to o show what works or not, or to get a second opinion. In this regard, a prototyping function can manage a certain amount of tension between promoters of a new system and promoters of a more routine-based system (regardless if it originates from R&D or Production). This can be compared to the role of an interface actor [Legardeur et al. 2010], providing some explanation for the importance of prototyping per se in innovation activities (e.g. [Brown 2008]). The results from this study indicate that a prototyping function

can be seen as an interface function between R&D and Production. The empirical base for which this study is relying upon consists of data from projects awarded for their innovativeness. The consequence of such a sampling is that only retrospective data is available. Thereby, there is always a risk that respondents will omit information, reconstruct the story or simply not remember events. Hence, interviews with several respondents from the same project were conducted when possible. Moreover, since only projects regarded as innovative are included in the study, it is not possible to discern whether more routine projects exhibit similar or different behaviors. Implications from this study should therefore be limited to efforts of a more innovative nature.

6. Conclusions

This paper aimed to add to our understanding of how project development teams manage the paradox of early involvement from production and innovativeness, i.e. that integration creates products better adapted for production, even though it favours incremental adjustments of existing operations and processes, at the expense of more radical processes. To achieve this, empirical data from eight projects awarded for their innovative output were analysed. This is critical because the paradox between early production involvement and innovativeness is more likely to present itself in more innovative projects than in more routine projects.

The main implication of this study is the importance of separation strategies in use at the interface between R&D and production. Projects utilize one or several strategies to balance the influence of either R&D or production in the project. Similar separation strategies, modularization and sequential processes, were identified in previous research on an organizational level. However, this type of separation at the micro level (i.e. by the individuals involved in projects or the projects themselves) has not been attended to in previous studies about cross-functional interfaces in organizations. The identified strategies related to, for example, separation in time, using separate equipment, strategies for introducing the products, separating between activities and having a separate function in the interface between R&D and production, i.e. a prototyping function. The results from this study lead us to conclude that a better formulation of the question posed in the title is: how to involve production and evolve an innovative offer at the same time? It is believed that the identified strategies of separation bring us one step closer to the answer.

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