# The spread of product development methodology: Exploring drivers and barriers in Swedish Industry

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**Abstract**

The outcome of Design, Innovation and Product development research is often manifested as recommendations in the form of methods, but these do not always find their way into industrial application. This paper elaborates on drivers and barriers for the spread of product development methodology based on 41 interviews with managers, designers, developers and knowledge brokers. Results indicate a range of motives for adopting methods including e.g. coordination of different actors, generation of documentation, methods serving as tools for various design tasks etc. However; the value of tools must be seen in relation to local conditions and practices. The spread of methods occurs between and within organisations and may be actively supported while ideally "good tools spread themselves". Participants call for methods to be scalable or malleable, guiding, informing and enabling without constraining or enforcing too rigid procedures.

*Keywords: Product development methods, knowledge diffusion, Design, Innovation*

## 1    Introduction

The practice of innovation, design and product development is sometimes decoupled from theoretical foundations, while "results of academic research are often insufficiently disseminated to the industry" [1]. Attempts at operationalizing theoretical knowledge often take the form of methods. Design research often aims at describing or prescribing some way of working [2-3] and has a long tradition of proposing methods [4]. A method can bee seen as a set of "rules that determine classes of possible procedures and actions that are likely to lead on a planned path to the accomplishment of a desired aim''[5]. Less formally, a design method can also be defined as "any identifiable way of working" aimed at improving the product development process [6]. Methods take different forms ranging from simple techniques for e.g. ideation, concept selection etc., sometimes published in textbooks [6–8] to more comprehensive prescriptions. Blessing and Chacrabati [3] describe how these may take different character; a) approaches and methodologies providing overall frameworks for doing

design such as Systematic design [9] and TQM [10], b) guidelines, rules, principles and heuristics (e.g. Design for manufacturing [11]), and c) tools in terms of hardware or software.

Product development companies are under constant pressure to improve efficiency and effectiveness of processes to develop superior products. "The search for best practices to manage new product development is ongoing, driven by managers' desire to identify and implement an optimal new product development (NPD) process" [12, p. 106]. Various surveys on the use of methods have been conducted in e.g. Japan [13], Sweden [14], and UK [15]. It has been suggested that design methods enhance performance with respect to foci such as e.g. cost, system quality, environmental impact, manufacturability, time to market [16-17]. Yeh found certain techniques (such as FMEA) to have significant effects on NPD performance indictors suggesting that "Utilization of appropriate tools and techniques in the process of new product development (NPD) can assist firms to achieve better performances in launching new products"[18, p. 131]. Barczak found that while no specific factor guarantees success; "practices statistically more highly associated with the best included the following: The use of formal NPD processes /…/ Using multiple different types of qualitative market research, including voice of the customer, customer visit, and beta-testing techniques. Using engineering design tools such as compute raided design (CAD) and computer simulations"[19, p. 4]. There is hence reason to expect that the use of effective design methods may enhance the performance of product development companies.

However, uptake of methods seems to be limited [3], [17-18], [20]. Various possible explanations have been put forward. Method acceptance may be negatively influenced by factors such as complexity, conflicts between methods and poor compatibility with the existing processes, and presentation using vocabulary not commonly used in industry [17], [21]. One prominent reason for the poor uptake of design methods in companies is that method developers provide limited attention to the actual needs of companies [20], [22- 23]. There seems to be a gap between the knowledge and methods generated in academia and industrial practices. Our **aim** for the project presented in this paper has been to explore: Driving forces for use of methods in product development,  How methods are adopted and adapted to the needs of the organization,  Characteristics of "good" methods,  Success criteria and challenges for dissemination and implementation of methods. We have elsewhere elaborated on the topic based on a literature review [24]. In this paper we primarily draw on an interview study with respondents from industry who were asked to elaborate on: (A) What characterizes a 'good' method? (B) How do product development methods spread? What are some drivers and barriers?

## 2   Methods

Semi-structured interviews, lasting roughly one hour, were held with 41 respondents from 33 organisations. Respondents all had experience of using methods in their practice and were recruited through snowball sampling based on personal networks and referrals to acquaintances and colleagues. We wanted to get at a range of different respondents, representing different areas (e.g. engineering design, and industrial design) and company functions (addressing strategic and process management issues as well as operative design work). Participants also included knowledge brokers from organizations active in spreading methods (e.g. design consultancies, science and innovation parks).

We developed an **interview guide** focusing on overall issues, and exemplifying questions. This served as a backbone for our semi- structured interviews. Each interview explored three overall themes; (a) The participant: current tasks, methods used etc., (b) Experiences with

changes where new methods were introduced, and (c) General view on methods. We avoided specifying or defining the term method, allowing respondents to freely associate meanings and illustrate examples and experiences from their own practice relating to the topic. Half of the interviews were carried out as one-on-one meetings at the premises of the respondent, the remainder through telephone or Skype. Interviews were **audio recorded** and subsequently transcribed by a third party. **Transcripts** were condensed to 1-2 page summaries highlighting key issues and quotes. **Content analysis** focused on themes emerging under: Context (company traditions, individuals background, attitudes and knowledge), Qualities of methods, and Factors hampering or supporting the spread of methods. A bottom up analysis of half of the material was made by one of the authors identifying emergent themes. Three of the other authors then coded the remainder of the material comparing, negotiating interpretations etc.

## 3   Results & Analysis

Participants brought up simple tools and techniques (e.g. functional analysis) as well as more comprehensive frameworks such as Lean, commenting both on methods supporting holistic understanding and methods focusing attention to details (e.g. FEM). Drivers and barriers can be found in: methods (purpose, qualities), formalization, compatibility with current practices, and active efforts at implementation. These are briefly elaborated in the following text where [I#] refers to specific interviewees.

### 3.1   The use of methods

*Methods can support different tasks*. Purpose and disciplinary context set constraints and give methods character. Participants discussed a range of purposes for which methods were useful including coordination, communication, documentation, as well as operative development work. Some participants like [I22] described a need to survey and control projects with respect to quality. *Methods can **leave traces**;* "We need to have some method that documents that, quality, risk management and priorities" [I7]. *Participants brought up methods for a range of different design activities*. As an example [I22] describes having a well defined but fairly flexible process consisting of Research, Analysis, Creativity, Concept, and Evaluation. [I29] uses methods for defining the project, generating ideas etc. The company has various (rarely used) checklists that highlight different aspects. "We are not making art, nor craft, we are making industrial design. There are always a 1000 different requirements, and what is interesting is to take the compromise as far as possible /.../ but I wouldn't say that is structured".

*Many of our informants brought up or asked for methods **supporting work with customer needs***. [I10] describes how companies often are good at engineering but face challenges in finding customer needs. "We work a lot with customer discoveries, there are no answers in-house. /.../ Getting heads up on people experiencing problems and trying to understand " [I9]. [I14] tries to pinpoint needs in one sentence aiming to define what is New, Unique, and Difficult. "Its often about search, search, search, search- and finally we find something good". *Not all were content with current practices*. [I12] tries to anticipate customer needs and trends and use this as a foundation for development, and wants to work closer with customers. However, implementing new ways of working is not always easy; "there is no tradition of being 'out in reality', and a perceived need to push people to go out and see the real contexts as it gives a lot of insights. But it requires time. /…/ It may be that you have to force people. It is important to get out" [I20]. [I7] commented on many methods being very theoretical and a perceived lack of support in collecting and prioritizing requirements, stating that there is a risk of missing out on future needs: "The requirements are reactive".

## 3.2 Qualities of methods

While a method's usefulness is tied to purpose and context, there are some general desirable characteristics including relevance and demonstrated advantages, scalability, and ease of comprehension. *To be accepted, methods must offer some sort of **advantages relative other ways of working**.* "There is often not that much discussion as long as people understand what it gives. And sometimes they experience a need to do something specific /…/ I mean, it is not a good solution I come with if it cannot be implemented /.../ I could suggest a full decision making process with tools and sensitivity analysis etc. but it would not give the organization especially much right now" [I15]. *Methods must have credibility prima facia, but also beyond that.* [I4] parallels methods with self help literature: "It all looks easy from the outside but once one tries to apply it, it is not". "[The process] was well received when we presented it. Everyone thought it was very professional and thought through... you sort of like the structure in it. However I now see, in retrospect you can notice that they don't personally think we need to work that way… so a certain resistance is noticeable" [I16].

*Methods need to be **proven in practice**.* Several of our participants point out that methods that are too theoretical and that have not been proven in practice will fall flat. "We try out a lot of things. What lives on is that which give very concrete feedback" [I17]. The same participant further describes how feedback mustn't be vague, take long time and be academic: "In that case someone has to order the use of it, there is no spontaneous use of the method". *The **criteria for what is a good tool** may differ between industry and academia;* "it doesn't matter where it [methods] come from. Our challenge with academia is making it applicable. We are not that interested in whether something is proved, but in how it helps us think" [I10]. [I4] describes academia as more process focused and contrasts this to a focus on outcomes/goals. [I16] describes how he thought about methods differently at the university and stresses that reality is complex. Often several methods are considered: "So it is not only the method being considered but one considers methods that are supposed to address different issues" [I15]. *Methods must in some sense take into account the complexity of reality* [I4].

*Methods that have notable **concrete results** have greater chance of being accepted and spread.* According to [I7] tools can also increase team spirit; "Good tools spread themselves". [I13] describes how "There is a lot of energy in the innovation jams". One of the most important factors for ideas to take on is visibility. /…/ You almost have to see that it lead to something". Getting overviews is desirable; "I believe the holistic perspective on development to be important" [I22]. "Methods that can take a large amount of information and do something graphical with it tend to get used" [I17]. [I11] comments on business model canvases as a simple and easy to learn method: "The visual overview is worth its weigh in gold and it makes them understand their own business model and thinking much much better.

*Methods must also be **easy to comprehend**.* [I7] describes how a key challenge is complexity: "Even something as simple as FMEA turns into a manual". Methods that are easier to apply are more likely to gain acceptance. "I can tell you what doesn't work, it is when it gets too theoretical. Those who work with it daily have to feel involved and engaged and if the answer is only sort of 42, well then they can relate to it, cant understand what it is" [I10]. "Good tools are intuitive. If you need a system, that is a sign that things are not ideal" [I7]. *How methods are **presented also matters**;* "When you take methods that are a little more innovative and creative and a bit quirky, if you package it in something that is not as fluffy such as [specific company name for development process], then they gain more legitimacy. And it has been an incredible strength, because people may sit in service development projects and use these fluffy methods they normally would not use" [I13].

*Methods are more likely to that gain acceptance if they **do not require large initial commitments*** [I19]. [I4] describes scalability to be a key challenge and asks for procedures that are immediately applicable but extendable: "Every time one adopts a new method there is an organizational risk, moving away from proven established ways of working. New ways imply a need to learn, both internally and in terms of external parties and if it doesn't work relatively quickly there is a risk of killing oneself trying to making it work or abandoning it".

### 3.3 Formalisation and prescription

Methods can be seen as formal descriptions of procedures, which may allow making practices explicit, open to refinement and supporting coordination of different actors. *Methods and processes **blend with less formal ways** of working*: "Much of the work is intuitive" [I28]. Methods are not isolated but need to be fitted to other practices. "Culture, everything is culture, that's where you end up... Its not only a process" [I20]. [I12] aims to be highly innovative but then funnel it down to what is realistic based on the production infrastructure: "It is sometimes a systematic work, but sometimes more spontaneous". "We use the material from our [early] analysis when we are tying things together. It gets formalized. In final meetings we check it so that we with good conscience can present it to the client" [I29].

*Making practices **explicit** may be a driver for formalizing procedures.* ". I mean; you don't have to be very normative but you should be aware of what you do /…/ I think it is better to have awareness and follow a process than to not have anything. You at least have to be able to say this is what we did last time, and this was the result" [I9]. *Formal procedures may support **coordination***. Standardization makes things easier to coordinate, and also makes it easier to explain procedures to new employees [I1]. [I16] sees a need to standardize development process. "The stage gate is a formalized way of presenting where we are in the process". A central driver is regularization; "We cannot have an organization with 40 000 people who do things their own way" [I7]. *Formalisation can also support **communication**, which was perceived to be especially important in working with clients.* [I22] points out that it is important to be able to describe to the client how different pieces fit together. There is a need for methods that are effective in aligning perspectives. "The challenge is never to understand what we can do if you ask me. Rather, the challenge is to make *them* understand what we can do /…/ We have defined our own tools. We originally did it as a way of motivating what we do to inexperienced clients" [I29]. The participant describes how this is necessary in order to communicate and justify the number of hours that goes into a project. Yet today's methods are not necessarily enough. [I16] sees a challenge in spreading information throughout the organization including sales, about how to think about needs, ideas, how to ask the right questions, identifying information and so forth.

*Formalization can also support **refinement***. [I17] describes having been part of introducing a lot of different ways of working. "The goal is often to get at systematic approaches. On a basic level its is about documenting what has been done and learning from it and multiplying the insights". [I9] claims that there is nothing more useful than a good model. It is about helping you think and act, to sort and know what is important, and to do that you need mental tools. "Perhaps not so much processes and description of steps but understanding that it is about communication insights". *Methods and structure can also give a **sense of security***: "Systematic approaches may create possibilities for breaking the boundaries of a certain industry and go deeper into how one is conducting development" [I4]. [I20] also describes how some people find templates reassuring while there is often a focus on formalities as these are easy to measure. [I4] comments on the value and drawbacks of formal and informal procedures: "With the experience based it is often about working with the knowledge in the

industry and less important to note every step taken". He further describes how traceability is probably higher with formalised than experience-based approaches.

Formalized approaches also have drawbacks. [I28] describes that *using methods **can feel inflexible, formal***. "I don't like ready made forms for... You should have something that leads you forward but that does not tell you where all the rocks and holes are because you should sort of feel that yourself" [I10]. One participant describes how structured prescriptive processes do not necessarily create team spirit and sense of achievement: "using process management to replace task management. The boss standing over and watching everyone work /.../ people have to be engaged. We have to trust them. And in order to do that, we cannot manage them by watching what they are doing and tracking how they are spending their time" [I19]. *Methods **should not over constrain***: "The process does not go into micromanagement. We have a process consisting of phases, within which there are activities. Activities are realized by methods. But no one is forced to use the methods /.../ It leaves space for the project manager and perhaps it is better to have a project manager that can handle that freedom " [I20]. *Some methods are detailed step-by-step instruction whereas others are conceptual models for thinking around a certain issue*: "The strengths of business model canvases is that it draws up an overview that I can then ask further questions about. It gives me a map to navigate by, not more" [I10]. *Not all methods enable, formal procedures can hinder.* [I17] describes how a formalized process in place to support incremental development can hamper more radical innovation. The radical ideas don't get very far as they are not very well developed from the first place and hence get stuck in the gates.

### 3.4 The industrial context

The spread of methods depend on characteristics of the receiving organization. The degrees to which the companies actively define and refine their development processes vary. The companies in our study come from different lines of and vary in size [I4] describes how it in small company is easier to sit down around a table and have discussions whereas a larger company may have a greater need for coordination and quality assurance. *Traditions and relevance of methods vary with industry*: "in some industries it will work well, but when you transfer it to another industry you may loose the effect because the structures are different /…/the small textile business and the large automotive company is different in nature" [I4]. [I22] highlights the different conditions; it may be difficult for small and medium sized companies to take the costs for large research projects. *Type of products and production facilities affect what methods are relevant*. [I16] describe working a lot with paper prototypes. Overall most is incremental due to the paper production process and what investments are required to achieve a change.

*Many of the respondents have some **formal process in place***: "we talk a lot about process development. We have our own development process, which is well defined; we have defined a lot of tools. We barely use it and that's not where the challenges are, we need to get more projects, that is the main issue" [I29]. Methods broker [I14] has tried to build up their own model focusing on Insight, Ideation, and Implementation. The process and associated methods have been documented on a website. In [I14]'s case this is aimed at educating new recruits as well as clients. *Having a process in place does not mean it is always followed*. [I1] points out that there are standards "for everything" but that uptake of standardized ways of working is affected by awareness and relevance. As there are many standards, it is difficult to overlook them and it is sometimes hard to see which one out of several is in play. [I4]'s organization has a formalised process description. The degree to which it is followed varies; the closer to

production the more formalised is the work. Similarly [I1] describes how the formal process is more rigidly followed in larger projects.

*Many participants **actively revise** practices.* "Just as much as we need to understand the client we also need to understand ourselves and our business. We cannot develop this more than we develop our own business" [I10]. "I think we experiment quite a lot with development methods also in quite an explicit way" [I9]. [I1] describes a willingness to learn and refine working procedures with the organisation devoting roughly half a day every other week is to operations development. This is done locally but it applies to the whole organization and results / lessons learned are spread between groups. *Continuously revising working procedures may have benefits but also drawbacks.* "People in the company don't seem to mind changes. It is natural to evolve. However there is also comfort in sticking to the old, and possibly also a fear of what might happen" [I12]. Some participants also expressed frustration about continuous changes consuming attention and effort that in their view could have been spent on development projects.

### 3.5    Spread & Active implementation of methods

*Some methods spread **horizontally** between organisations, working groups etc.* [I7] describes having an improvement manager who travels the world and who is part of various networks. Several participants describe having brought some methods from training/education, and learning more from various projects. [I9] points out that external consultants contribute to knowledge diffusion, while [I4] problematizes this; Method brokers are not necessarily going to be frank about the shortcomings of the methods they pitch.  This spread may flow both ways: sometimes methods and ways of working gets picked up from spending time in a clients organisation [I28]. *Methods also get picked up from others in the same industry.* "When one follows a topic it is due to an interest, and it can be enough that someone else in the same industry has worked with it or that someone one looks up to has done it..." [I4]. Change may be triggered by e.g. Macro-economy, or driven by a specific person. Some methods are implemented on request from clients/customers who require it [I7]. Also timing can be important. "One can sometimes feel that there is sort of a cult surrounding certain methods and that some follow along because it is the fashionable thing to do" [I4].

*Some procedures are implemented vertically **top-down** from management or **bottom-up***: "You always have to find a balance between bottom up embedding mechanisms and top down embedding mechanisms. /…/  we are in a context where there is a need for a lot of top down, because it is a big company, a mature company, with an engineering culture. /…/ I find the bottom-up mechanism easier to comprehend. It is easier for me to get control and make it happen" [I13]. [I1] describes how it is difficult to implement top down in a big organization, as there are specifics that vary. Initiatives are taken upstairs reach middle management but don't necessarily get implemented. [I7] describes how *many tools require **an implementation process** and that the pay back time is often long*; "Rake, plant a seed, harvest". To implement something you have to create a discipline around it, new methods can be tied to the existing structures in which people work [I19]. When something is introduced affects whether it will be accepted: "timing is a crucial success factor. Projects move in cycles, line organizations have budged years etc. When one introduces something is important, that it paces in with their other work" [I15].  "If you are to provide methods and tools you have to work very much with the intellectual context in which they are to be used" [I11]. "To create change in an organization you have to change the dialogue or discussion. What is it we are talking about by the coffee machine, what sort of subjects are we bringing up, what sort of questions do we ask each other? If we can change that dialogue we also changed the company" [I10].

*The uptake of methods is affected not only by its performance but also by e.g. **how busy the organization is** with other issues.* [I15] describes how there is a trade-off between benefits derived and effort taken: "Because they are busy as it is. And it takes time for them to get involved with something new" [I15]. *There is sometimes a **conflict between old and new ways of working***; "much of their sense of security was based on what they knew about their profession. /.../ and having to redefine ones professional roles may be tough. So it is not necessarily the method or work as such but that there is a need for a long phasing in period" [I4]. [I16] suggest that loss of voluntary control can create resistance: "there can be a certain resignation due to how top management have been handing out tasks, e.g. they want there to be huge innovation projects, one wants big changes and grand ideas and so forth. At the same time one has to deal with service, customer care where no compromises can be made". *Interpersonal factors such as social **prestige, legitimacy etc. affect implementation***. "I think it [resistance] may to a certain extent be about prestige/.../ I think these people are so pragmatic they think they don't need anything telling them how to make decisions" [I16]. The same participant further exemplifies a problematic situation: "it became very prestigious and everyone defended their own are and thought it was most important and the could not see the value in making good of each others ideas and building on them, but were determined their own ideas were the best" [I16]. "Working with a team of people, having them making commitments to each other and monitoring whether they are meeting them in very short cycles, creates relationships. It creates trust" [I19].

*Methods are more likely to spread if they gain trust and **acceptance from key stakeholders***, e.g. management or opinion leaders [I4]. [I1] exemplifies this by how the company has had a safety officer who has been very active in communicating and spreading methods for risk analysis. *Who advocates a certain method can matter*: "I almost become more of an innovation expert outside the company-group than within it". "Being classified as designer in an engineering company does not give a high rank, why I wanted this strategist title that I have been working for ever since I started here, but first now am I senior enough to argue it" [I13]. *Various **techniques can be used to get acceptance***. "That is what I work with right now, trying to influence bottom up to maybe make these things happen, perhaps changing the kind of thinking that goes on, to perhaps say lets try it. I use that kind of methodology myself when I do skunk work, and that is something I do under the radar" [I13]. [I19] uses a training procedure where participants are introduced to basic routine practices. After a few weeks they see the benefits and come back for more. The ideas become immediately applicable and knowledge can be furthered in a series of workshops. [I17] First having one person trying the method, then has that person instruct and explain benefits, as he/she will probably have more trust than the manager. "If you train people and the method stays when no boss is around then there is probably a benefit from the tool. However it takes time; often courses/training means that people show up due to management decisions" [I7].

## 4   Discussion

Good methods enable and spread between and within organisations. The spread of theoretical knowledge embodied in product development methods depends on the methods demonstrated ability to yield relative advantages in relation to specific purposes and local needs. Drivers for using methods included formalisation of processes supporting coordination. Desirable characteristics included flexibility in being adaptable to practices, and scalability with low initial commitment.

Drivers and barriers can be found in qualities of the specific methods as such, also organisational issues, and especially fit with established practices. This is consistent with

more general frameworks for innovation diffusion / adoption such as the one by Rogers [25] highlighting issues such as Social system, the Receiver, the Communication system, and Perceived characteristics of the innovation. Of these qualities of methods commented by participants are seemingly congruent with what Rogers emphasises as perceived characteristics of the innovation; Relative advantage, Compatibility, Complexity /simplicity, Trialability, Observability which we believe to be central to good methods. Turning these into recommendations for academia, relevant to development of methods may be more challenging, especially in terms of developing relevant methods that are compatible with established practices, and yield results, without requiring too large efforts. Several of the interviewees called for methods that were scalable or malleable, guiding, informing and enabling without constraining or enforcing too rigid procedures.

The explorative approach employed in the study allows us to identify some significant drivers and barriers. The data reduction procedures together with a bottom up analysis points to central factors, while limiting comparisons and what conclusions can be drawn across participants. Future work will include a more extensive analysis, elaborating parts of the material in the light of theory. Of special interest are the factors surrounding formalisation, the learning of methods, and how methods enable but also constrain.

The development of methods can in part be seen as a way of getting at a rational approach for design, often exemplified with the works of Simon [26]. The technical rationality perspective has been criticised by e.g. Schön [27], and said to mismatch how designers work [28]. The challenge in spreading methods may to a certain degree have to do with differences in goals and traditions between academia and industry. That topical issues related to design, development, and innovation seem to be "insufficiently founded from the theoretical perspective" [1] rests on an assumption that theoretical knowledge has something to offer. However, as pointed out by one of our interviewees industry may have a greater concern for goals and products than idealised processes; judging tools and knowledge by relevance rather than truth. In this paper we have stressed some drivers and barriers for the spread of theoretically grounded knowledge. Our interviewees called for methods that were scalable or malleable, guiding, informing and enabling without constraining or enforcing too rigid procedures. The spread of methods may call for active implementation, but also for grounding normative propositions about practice in practice.

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