

INNOVATING INNOVATION: TOWARDS A NPD-MANAGEMENT TAXONOMY

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ABSTRACT

This paper reports on a government funded research project that was aimed at the development of a meta-method to improve NPD-processes in industry by the use of tools and methods available in literature. We choose to develop an industry-relevant taxonomy that could serve as means to categorise the NPD-tools and at the same time could facilitate the process of improving the NPD-process itself, hence 'innovating innovation'. A design inclusive research process with various design and probe cycles resulted in the first reliable version of the taxonomy.

Five case studies provided the view from the NPD trenches that informed the creation of an industry relevant taxonomy covering all NPD tools from literature. The subsequent design and probe cycles were performed with heavy involvement of the different potential users from industry, consultancies and academic institutions. During the design cycles the taxonomy and its operational method were tested and refined and named the NPD Management Canvas. The enthusiastic reactions in a final proof-of-concept showed us the value of the meta-method and the reliability of our taxonomy.

Therefore the Innovation Management Canvas proposed in this paper looks very promising for application by academics (tailoring research portfolio) and by industry to innovate their innovation processes.

Keywords: Innovating innovation; NPD-methods; taxonomy; Innovation process management

1. INTRODUCTION

The ministry of Economic Affairs, Agriculture and Innovation in The Netherlands aims to improve the competitiveness of the Dutch industry. The structure of Innovative Research Programs (IOP) in which academia and industry collaborate in the development of innovative technologies, tools and methods, is one of the means to enhance this competitive position. The IOP Integrated Product Creation & Realisation (IOP-IPCR) forms the context of the assignment here reported on. The IOP-IPCR runs now for 8 years and has delivered some interesting new tools and methods for the field of NPD (ref IOP) and it is considered time to bring this knowledge to the Dutch industry. The question posed to the authors of this paper is: how to transfer newly developed NPD tools and methods to a large part of the Dutch industry? It was soon realised that, the few methods created (and under creation) under IOP-IPCR flag form just a tiny addition to the sea of NPD tools and methods already available. It was also realised that only a very small portion of the industry would be interested in the innovative IPCR-tools and by far the majority of companies will have very different

needs for improving their NPD-processes. And because of all the contextual and situational influences it is to be expected that each company will have a very different set of needs that all together might even call for taking into consideration all NPD tools and methods available. One company might benefit from making a shift to user-centric development while another needs to pay attention to project selection processes because of an overload of NPD-projects in the portfolio. But even, apparently simple things like poor teamwork or poor collaboration with other disciplines and functions might provide opportunities to improve competitive position. All in all, there are a myriad of need patterns across the total industry which calls for a different approach. Therefore it was decided not to limit the project to just transferring the innovative (and often expensive) IPCR tools and methods, but to look for an industry relevant taxonomy that would provide an overview of existing and new NPD tools & methods.

One could wonder, why create a new structure since such foundations are widely available in literature, in the form of handbooks (for example: Griffin & Somermeyer 2007), NPD-process views, stage gate models, organisational structures, etc.? Yes, it is true these are widely available but they miss the aim we have to improve NPD from a wide perspective and not just a part of the product development process or just the improvement of a single project or simply applying best practices. It is not just looking for critical success factors in literature, check if they are present and if not implement them.

For instance, many researches have defined the critical success factors for new product development, including Lester (1998), Poolton and Barclay (1998), Cooper (1999), Lynn et al. (1999) and Sun (2005). Cooper (1999) defines eight factors of success: (1) Up-front homework pays off, (2) build in the voice of the customer, (3) seek differentiated superior products, (4) demand sharp stable and early product definition, (5) plan and resource the market launch ... early in the game, (6) build tough go / kill decision points into your process – a funnel, not a tunnel, (7) organise around the cross-functional projects teams, and (8) build an international orientation into your new product process. All these success factors are in one way or the other related to tools and methods that in various forms can be of help. Like, there are many ways to build in the voice of the customer or to do up-front homework. And having cross-functional teams is by far not enough if transitions and interfaces with the world outside the team is not well organised. So the question is, what is the 'fitness' of your present NPD-processes and are possible tools and methods that could be of help improving it.

Another stream of literature describes NPD tools & design tools in the context of the NPD-process that starts with the (fuzzy) front end of innovation and ends with market introduction or launch (e.g. Andreasen & Hein 2000, Buijs 2003, Ulrich & Eppinger 1995). Another stream of literature focuses on the process structure of NPD as an innovation process and its decision points captured by stage gates (e.g. Cooper & Edgett 2009) within the actual design process. When it comes to assessing the performance of an NPD-project, Blindenbach-Driesen et al. (2010) differentiate between organisational performance and product performance. This is on project level and we are looking for means to improve NPD on the organisational level.

Adams et al. (2006) have defined seven categories in the innovation management process: inputs management, knowledge management, innovation strategy, organisational culture and structure, portfolio management, project management and commercialisation. Moreover there are a large variety of handbooks that describe all the stages of the NPD process in detail and are accompanied by stage-relevant NPD and

design tools. Finally there is a large body of literature that describes best practices of companies that on continuous basis outperform their peers (e.g. Griffin 1997, Edgett 2011). However, none of these help organisations to assess opportunities for innovating their own NPD processes and subsequently link these to available NPD-tools.

The meta-method that we were looking for must fulfil the following requirements: 1) it must overarch the total NPD-process. 2) it must provide a taxonomy relevant to industry, 3) must allow a contingent approach for practitioners to identify opportunities to improve their NPD-processes. Moreover, the taxonomy must cover existing and ‘state-of-the-art’ NPD methodologies and tools.

In addition, during the project it was realised that new product development and its abbreviation NPD is not common vocabulary within industry. Companies rather use the word innovation or its verb innovating when they refer to processes of developing new products or services. To keep our language relevant for industry we decided to name the method to improve the NPD-processes ‘Innovating innovation’ as to indicate that we are developing a meta-method to innovate the existing product/service innovation processes, that is, to help companies to identify opportunities for improvement thereof.

The paper reports on the identification and development of the industry relevant taxonomy and how to work with it insight organisations. The remainder of the paper is structured as follows. First we will discuss the overall approach taken in this project. Thereafter, the successive steps and their individual approaches, including their intermediate results, are reported in detail. The paper ends by discussing our findings, the next steps and some consequences for further research.

2. METHODOLOGICAL APPROACH

What we were looking for is as such not available in the NPD literature. At the same time it was realised that we needed to include industry in order to secure the relevancy sought for. To be able to solve this problem we chose to use a design inclusive research methodology as proposed by Horvath, which allowed us to embed ‘design’ as a research means (Horvath, 2007, 2008). The research approach covered five consecutive and parallel research and design avenues.

As a first exploratory step (1) (pre-study) we looked at what industry seems to bother regarding their NPD-processes. If we are to help industry to improve their NPD processes we need to stay close to what NPD-actors and stakeholders are experiencing in their daily practice. This field data on positive and negative experiences of NPD actors was gathered by conducting five case studies. In the next exploratory step (2) a literature review was conducted to identify as many NPD related methods and tools as possible. Thereafter (3), the results of these two steps, the experiences from the trenches of NPD and the methods and tools from literature, were combined and clustered to design the conceptual version of the taxonomy. Additional to the taxonomy the insights gained during the case studies formed the input to design (4) a fledgling method for practitioners how to use the taxonomy as the meta-method aimed at improvement of their NPD process. The taxonomy and methodology were verified and improved (5) using expert design sessions and evaluated during two participatory design sessions with groups of practitioners. During the participatory design sessions the methodology and taxonomy was first used, and then evaluated and improved. These sessions provided input for another iterative design loop of the assessment methodology. As a final verification step (6) a proof-of-concept of the methodology was conducted with a group of practitioners from one department of a large firm (post-study).

3. DESIGN INCLUSIVE RESEARCH: STEPS, APPROACHES AND RESULTS

This section reports on the six steps taken during our research project until this moment of writing. As mentioned we had six consecutive steps that each brought us further to our goal of developing a meta-methodology for innovating innovation.

3.1 STEP 1: PRE-STUDY: GATHERING FIELD DATA

The goal was to make an inventory and analyses of often occurring problems related to the development of a new product / service and within the entire NPD process.

3.1.1 APPROACH STEP 1

The field data was collected by means of five case studies (Yin 2009, Flyvbjerg 2011). The case studies were focused on recording recurring incidents experienced as critical regarding NPD-progress by NPD-actors (Flanagan, 1954). Such experiences would provide us with a view from the trenches representing the life in NPD organisations. This was done by conducting research at five different organisations to identify the main problematic areas within the NPD process (Table 1). Cases 1, 2, & 4 were large internationally operating companies. Case 3 and 5 were medium and small sized companies. The research was carried out not only at the managerial level but also at the operational and functional level. The methods used for collecting data were semi-structured interviews and the nominal group technique (NGT) (Delbecq & Van der Ven 1971, VanGundy 1992). All participants were asked to describe recurring positive and negative experiences across the many NPD-projects that they have been participating in. The goal was to build a base of observations related to a large spread of NPD-projects, rather than experiences that occurred only in one particular project.

Case 1	NPD Fast moving consumer goods
Case 2	R&D Telecom services
Case 3	NPD Hearing aids
Case 4	R&D Adhesives
Case 5	NPD Escalators

Table 1. Overview of cases

The data extracted from the interviews and group sessions resulted in a large pile of positive and negative experiences seen from the perspective of the actual NPD-actors and stakeholders. The data was analysed first within each case followed by a cross case analysis.

3.1.2 RESULTS STEP 1

This resulted in some 150 positive (what goes well) and some 200 negative recurring experiences (what is hard / goes wrong / cannot be solved) of the actors within the NPD process. The numbers are just to give an impression, since it is not the amount of experiences we were looking for neither an exhaustive inventory. We were looking for data that could help us developing an industry relevant taxonomy and we realised that such relevancy wouldn't come from categorising the NPD tools as found in literature.

Because the recurring experiences gathered are individually felt in the first place and locally validated by NGT-sessions, it was realised that these experiences are to be seen

as symptoms for underlying causes that form the root and initiation of such an experience. In addition, it was found that in the past decades NPD processes have gone from simple and transparent to complex and collaborative processes with parties from outside the team / organisation (e.g. increased technological content, supplier involved, networked (open) innovation, etcetera). Moreover the interviews also showed that NPD processes can only be improved if the need / area for improvement has been assessed or is known to the company.

3.2 STEP 2&3: LITERATURE STUDY AND TAXONOMY DESIGN

This section reports on the literature search (Step 2) aimed at the identification of NPD tools & methods as well as Step (3) being the subsequent integration of the field data and tools from literature into the conceptual design of the industry relevant taxonomy.

3.2.1 APPROACH STEP 2 & 3

First, we identified and clustered some 200 NPD tools and methods* by similarities regarding the added value these brought to the NPD process. Thereafter, we searched for ordination principles from management and NPD/design sciences that were relevant to the development of the taxonomy.

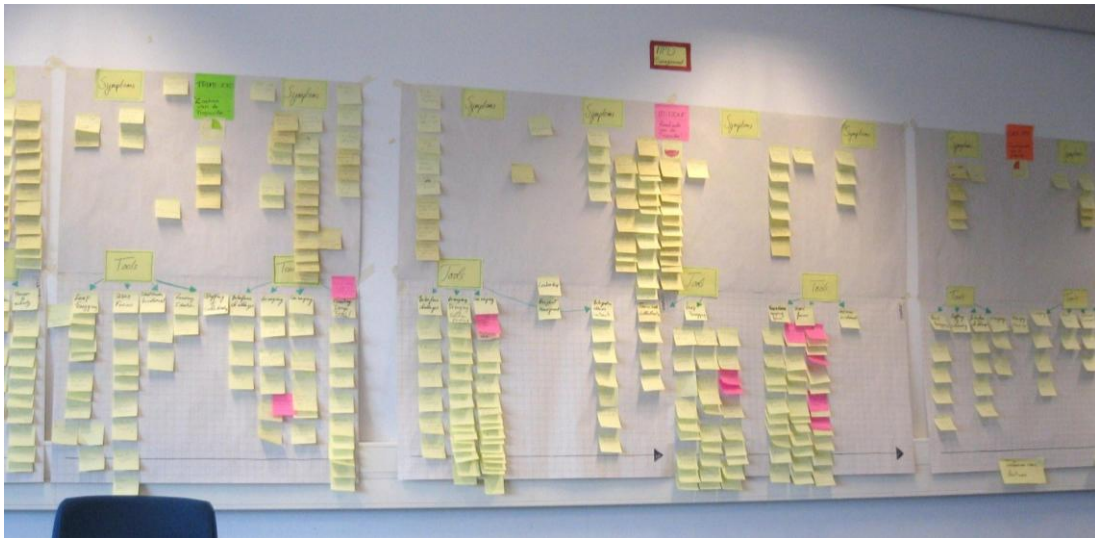


Figure 1. Categorisation of symptoms from case studies (top) and tools (bottom).

We looked for a process perspective for identification of possible sub-processes within NPD as well as for a categorisation perspective that could be of help to cluster the NPD tools. As a next step, a co-evolutionary process focused on clustering the data that was gathered during the case studies on one hand and on relating these symptoms to the tools that could solve or prevent them on the other hand. As a result, the symptoms that were identified during the case study research were placed within the NPD sub-process in which they could be solved or prevented and clustered into one of 10 sub-categories depending on what had to be done in practice to overcome these issues and improve the NPD process (Figure 1). This resulted in a taxonomy that provides an overview of NPD relevant tools.

* Tools and methods are referred to as tools

3.2.2 RESULTS STEP 2 & 3

It was found that especially design related tools within one category range from simple to complex and that their applicability is context dependent. For instance, user centred design could range from simply talking to some present users to participatory design. Choosing for one or the other is contingent to the situation the company is in. The proposed taxonomy should help practitioners select NPD relevant tools that can be applied to improve their NPD process both related to the development of content (activities) and to the management and organisation of the NPD process.

The taxonomy is divided into two overarching management categories: *NPD Management & Business Management*. While categorising the experiences and relating them to tools that could prevent or solve the situation, we realised that some of the critical incidents needed to be addressed by actors outside the direct confines of the NPD-territory. For that reason we added the overarching *Business Management* to our taxonomy. The entire product innovation process, under *NPD management*, is divided into three sub-processes, being (1) the search for a new proposition (*Front End*), (2) the development thereof (*Strict Development*), and (3) the implementation of the proposition (*Industrialisation*). The fourth process is *Business Management* and as said, it overarches the *NPD Management* and its three sub-processes (Figure 2).

<i>Business Management</i>		
Symptoms		

Tools		
<i>NPD Management</i>		
<i>Front End</i>	<i>Strict Development</i>	<i>Industrialisation</i>
Symptoms	Symptoms	Symptoms

Tools	Tools	Tools

Figure 2. Abstract visualisation of sub-processes in the taxonomy

These four processes are each divided into a *Management & Organisation* section and a (*NPD*) *Activities* section. Within these sections a further sub-division into 10 categories of NPD relevant tools has been made. The proposed categorisation of tools & methods is based on the symptoms that were identified during the case studies as well as inspired by the 7 S Framework developed by Waterman, Peters & Phillips (1980).

The *Management & Organisation* section consists of all tools related to the management and organisation during the NPD process. The categories are: *Vision / Strategic alignment; Leading, Managing & Planning; Culture; Skills & Staffing; NPD Process Structure*. These categories are inspired by the 7-s model of McKinsey.

The *NPD activities* section includes all tools that can be used during the realisation and introduction of the new product /service. The categories are: *Business cycle activities; Interface activities; Product-use cycle activities; Product realisation cycle activities; Production cycle activities*.

The sub-divisions and categories are equal in each of the four (sub-) processes, but the tools themselves are often different between the (sub-)processes. For example, most tools that are helpful during the Front End are not of any help during the Industrialisation and can even be counterproductive in that context. Table 2, on *Management & Organisation*, and Table 3, on *(NPD) Activities*, provide detailed definitions of all the categories.

<i>Management & Organisation Section</i>	<i>Examples of Tools</i>
<p><i>Vision / Strategic Alignment</i> In any stage of the NPD process decisions taken and activities performed should be aligned with the strategy (and vision) of whole the organisation and/or only at the level of the product line. Also alignment with strategic steps just undertaken like the acquisition of another company.</p>	<p><i>Business Management:</i> Porter five forces analysis <i>Front End:</i> Opportunity recognition <i>Strict Development:</i> Strategic guidelines <i>Industrialisation:</i> Kaizen</p>
<p><i>Leading, Managing & Planning</i> Represents the S of Style and covers the style of managing in the organisation as well with NPD-projects. Leadership of projects and management.</p>	<p><i>Business Management:</i> <i>Front End:</i> Contingency Planning <i>Strict Development:</i> Toll gates decision making <i>Industrialisation:</i> Empowerment</p>
<p><i>Culture</i> Represents the S of Shared Values and covers how people work and behave inside the organisation. The way we work here' is a famous expression illustrating the culture of an organisation. Also the unwritten rules of the game (Scott-Morgan 1994) is what is meant with Culture.</p>	<p><i>Business Management:</i> Hay days <i>Front End:</i> Idea appraisal system <i>Strict Development:</i> Advanced Collaborative Environment <i>Industrialisation:</i> Learning culture during ramp-up</p>
<p><i>Skills & Staffing</i> Here we address the S of Skills that are in the organisation. We address it at three levels: the level of the core competences (Hamel & Prahalad 1990) or competences of NPD/R&D and the competences of individual organisational members. The S of Staffing refers to the processes related to assigning organisational members to projects. Also hiring new members or programs on organisational development fit under this.</p>	<p><i>Business Management:</i> Leadership programs <i>Front End:</i> Belbin Team Roles for staffing <i>Strict Development:</i> Team kick-off meetings <i>Industrialisation:</i> Job rotation</p>
<p><i>Structure</i> Is based on the S of Structure as in the 7-S model. The process structure of NPD, the division of responsibilities and mandates, line and staff functions. Structures around open or networked innovation are part of Structure. Collaborative agreements among supplying organisations.</p>	<p><i>Business Management:</i> Stage Gate <i>Front End:</i> Working with Projectas <i>Strict Development:</i> Concurrent engineering <i>Industrialisation:</i> NPD-sign-off regulations</p>

Table 2. Definition of the Categories of the Management & Organisation Section

The seventh 'S' of Systems is what we see as the S covering all activities in each of the four processes. So, activities related to the Business Management, to the Front End, Strict Development and Industrialisation. The latter three being the activities related to the actual product development processes. We have divided the activity section into five categories, each related to a cycle of recurring activities. There were no NPD-tools that we couldn't fit in one of the categories. Some tools however, could be positioned in more than one category. This was either due to multiple foci of application or due to the fact that a tool covered more than one application area. One of the categories within the division of Activities, Interface activities, was particularly empty, that is, only very few tools related to these activities were found in literature.

<i>NPD Activities Section</i>	<i>Examples of Tools</i>
<p><i>Business cycle activities</i></p> <p>Development activities related to the business cycle of the new product/service, like marketing activities, exhibitions, salesman training, cost calculations, product economics, return on investment calculations, etcetera.</p>	<p><i>Business Management:</i> AIDA</p> <p><i>Front End:</i> Business case</p> <p><i>Strict Development:</i> Virtual Reality Shopping</p> <p><i>Industrialisation:</i> Design of Persuasive Strategies</p>
<p><i>Interface activities</i></p> <p>Interface activities form a special category. All activities related to the transfer, transition, transformation and handing over of (partially) project results to other sequentially or reciprocally dependent actors in NPD. Literature is very scarce on interfaces and how to handle them. However, the companies from the case studies experience considerable problems with interfaces.</p>	<p><i>Business Management:</i> 'Skunkworks'</p> <p><i>Front End:</i> Involve Lead Customer</p> <p><i>Strict Development:</i> Boundary Objects</p> <p><i>Industrialisation:</i> Ramp-up Meetings</p>
<p><i>Product-use cycle activities</i></p> <p>These are all development activities related to incorporating requirements related to the actual use of the new product/service into the product development process. Development issues related to energy consumption during use, ergonomics, end of life problems, feel and touch, use experiences, etcetera.</p>	<p><i>Business Management:</i> User Perceived Failure Severity model</p> <p><i>Front End:</i> Context Mapping</p> <p><i>Strict Development:</i> Human Machine Interface Ergonomics</p> <p><i>Industrialisation:</i> Managing Soft Reliability</p>
<p><i>Product realisation cycle activities</i></p> <p>All development activities related to the actual creation of the product. From sketching, rendering activities, CAD activities, Engineering methods, prototyping activities, etcetera.</p>	<p><i>Business Management:</i> Product Innovation Charter</p> <p><i>Front End:</i> House of Quality (QFD)</p> <p><i>Strict Development:</i> Rapid Prototyping</p> <p><i>Industrialisation:</i> Product Attribute List for product evaluation by consumers</p>
<p><i>Production cycle activities</i></p> <p>The development activities related to production, like design of moulds, plant lay out, assembly sequences, assembly instructions, production line testing, first out of moulds tests, zero-series, machine design, etcetera.</p>	<p><i>Business Management:</i> Supplier Selection</p> <p><i>Front End:</i> Technology inspired design</p> <p><i>Strict Development:</i> Factory Engineering</p> <p><i>Industrialisation:</i> Assembly Station Design</p>

Table 3. Definition of the Categories of the NPD Activities Section

3.3 STEP 4: METHOD DESIGN

This section reports on the design Step 4. To form the first conceptual version of our innovating innovation methodology we aimed at developing a procedure to handle the taxonomy in corporate settings. Ease of handling the taxonomy by actors from the field is a given requirement. Furthermore, the methodology should help actors in practice (or their) departments to (1) identify problems related to the NPD process of their organisation, (2) should provide directions for the improvement of their NPD process, and (3) provide guidance in the selection of appropriate tools and approaches.

3.3.1 APPROACH STEP 4

Based on the insights gained from the case studies and our experience a conceptual version of the methodology to handle the taxonomy in practice was developed. It was realised that the approach applied during the first step of case studies could form a base to start from. The conceptual version of procedures could then be used in subsequent

design iterations to find out what actors from practice as well as actors from academia could add. This will be reported under Step 5.

3.3.2 RESULTS STEP 4

The proposed methodology consists of four consecutive steps. In step 1 the positive (what goes well / what works) and negative aspects (what goes wrong / does not work / where there are problems) are identified by application of the nominal group technique. This worked well to get an idea of the status quo of the NPD process & organisation. During step 2 the positive and negative aspects (symptoms) are placed in the taxonomy in the sub-process where they occur and the category they are related to. This allows the participants to identify the areas with the most positive (areas that do not provide problems and are well organised) and negative aspects (areas in need of improvement). The most important negative aspects are then prioritised and marked. During the third step the symptoms (negative aspects) are moved to the sub-process and category where they can be solved and or prevented. In a final step the symptoms that were marked are identified and tools that can help improve these issues are selected from the taxonomy based on the situational needs, resources and experience of the company. The method should be used by NPD experts, preferably from the same organisation, during a session of several hours.

3.4 STEP 4: VERIFICATION AND IMPROVEMENT OF TAXONOMY AND METHOD

This section reports on the fifth step in which we tested and improved the concept of taxonomy and method in some consecutive design cycles. The aim was to arrive at first reliable version that could be used in a real field test in the next design step (6).

3.4.1 APPROACH STEP 5

We held two sorts of sessions: one in which we consulted experts from the field, academia and consultants. In the other sessions we invited NPD practitioners to participate in our design process, hence participatory design (Vink et al. 2008). Ten experts from academia and from several different consultancies were asked to evaluate the proposed taxonomy and method during expert design sessions. See Table 4 for an overview of the participants.

In addition, two participatory design sessions with actors from different organisations were organised, from both large firms and SME's, as well as from consultancies (Table 4). During these sessions the methodology was first tested where after participants were asked to provide feedback, both positive and negative and make suggestions for improvement of the taxonomy and the method to work with it.

Expert Design Sessions	1	Consultant:	Brand driven innovation
	2	Consultant:	NPD improvement
	3	Consultant:	Creative product development
	4	Consultant:	Efficient product development
	5	Academic:	Usability NPD tools & methods
	6	Academic:	Design & Innovation methodology
	7	Academic:	New Product Development
	8	Academic:	New Product Development
	9	Academic:	Product Innovation management
	10	Academic: Large firm:	Design Engineering and Employee R&D
Participatory Design Session 1	11	Consultant:	Technology
	12	Large firm:	Department head Research
	13	Large firm:	Employee Research
	14	Large firm:	Department head R&D
	15	Academic:	New Product Development
Participatory Design Session 2	16	SME:	Director and managing product development
	17	Large firm:	Department head R&D
	18	SME:	Employee in charge of front end
	19	Large firm:	Employee R&D

Table 4. Overview of Expert Design and Participatory Design Sessions

3.4.2 RESULTS STEP 5

All participants thought that the taxonomy was a viable ordination principle of NPD relevant tools. Moreover they highlighted the need for framework and process to guide them in their selection of NPD tools to apply. The industrial and consultancy practitioners found the connection between the symptoms in practice and the directions for improvement including the corresponding tools particularly valuable.

The advantage of the methodology is that it provides insights in both the positive and negative aspects of the NPD process of an organisation during step 1. By mapping these in the second step in the sub-process they occur and related to which category the process provides the participants with insight into the areas that go well and those in need of improvement. When moving the symptoms in the third step to where they can be solved or prevented many of the symptoms from *Industrialisation* moved to *Strict Development* and *Front End*. Similarly, most symptoms related to culture, structure and strategy moved to *Business Management*, which meant that they could only be improved through actions undertaken by actors from higher hierarchical levels and not by the people that participated in the sessions.

It was also found that when working with the taxonomy and identifying the areas of improvement, the tools and symptoms that were stuck to the sheets when we created the taxonomy (Figure 1) were a distraction from one's own problems and made it harder during the sessions to identify tools that are needed by the company. Based on these insights it was chosen to work with an empty 'taxonomy-structure' of a sub-process that can be used for each of the sub-processes during the proof-of-concept. In addition, it was proposed to include the current NPD-portfolio of the company in the discussion to create a better understanding of the taxonomy and its sub-processes. This also led to

adding an extra step to the procedure of handling the taxonomy: discussing all projects in the current NPD-portfolio and position them in the taxonomy. During the participatory design sessions it also became clear that if the methodology would be used by a group of people from one company and was aimed at truly improving their NPD process several sessions would be necessary to gain enough depth and insights during the analysis of the current situation and to devise a plan for innovating their innovation processes.

Since, all participants were very enthusiastic about the taxonomy and its process we thought a proper name was needed for clarity during future research activities and publications. We eventually named our taxonomy: the *Innovation Management Canvas* (see figure 3).

Portfolio									
Symptoms									
<i>Management & Organisation</i>					<i>Activities</i>				
<i>Strategy & Vision</i>	<i>Leading</i>	<i>Culture</i>	<i>Skills & Staffing</i>	<i>NPD Process Structure</i>	<i>Market</i>	<i>Interface</i>	<i>Product Use</i>	<i>Product Realisation</i>	<i>Production</i>
Tools, methods & practices									
<i>Management & Organisation</i>					<i>Activities</i>				
<i>Strategy & Vision</i>	<i>Leading</i>	<i>Culture</i>	<i>Skills & Staffing</i>	<i>NPD Process Structure</i>	<i>Market</i>	<i>Interface</i>	<i>Product Use</i>	<i>Product Realisation</i>	<i>Production</i>

Figure 3. Innovation Management Canvas.

3.5 STEP 6: PROOF-OF-CONCEPT

The final step reported here concerns the post-study aimed at testing our concept in real life. The taxonomy and its method were tested with an R&D capacity group from a multinational in fast moving consumables.

3.5.1 APPROACH STEP 6

The four participants (including their leader) were all from the same department and are specialised industrial researchers positioned somewhere in between research and development. Two participants of this group were just started to document and revise their (research) working procedures. Three sessions were planned beforehand. All

sessions took between around 4 hours and were facilitated by the authors and recorded/filmed. During the sessions an empty 'taxonomy' was used, i.e. a taxonomy with all categories but without tools. AO posters were provided with the sub-division of sections and corresponding categories for each of the (sub-) processes (figure 4).

These posters also included an area for symptoms and for mapping the NPD-portfolio. The process steps planned were as devised and improved during the previous design step 5.



Figure 4. Usage of the Empty Taxonomy Posters During the Proof-of-Concept

3.5.2 RESULTS STEP 6

Because the participants were from one department of a large multi-national and therefore acted in a very complex environment, with several different departments that were part of the NPD process, the sub-processes of the canvas had to be redefined and renamed during the discussion of the NPD-portfolio in the first session. Instead of using the proposed *Front End*, *Strict Development*, and *Industrialisation* it was concluded that it would be more applicable to use *Framing* and redefining the proposition, *Development* of the proposition, and *Transfer* of the output. This as to illustrate that the projects this particular group worked are found in between the R and D of this particular firm. Some projects a bit more D than R and also the other way around. But the adapted naming worked evenly well for this particular group. The discussion on the individual projects created insight into the complex relations between the different stages, projects and other departments that were working on them.

The sessions were a bit different than planned. Instead of doing a nominal group technique in general covering all four sub-processes at the same time we worked per sub-process starting from the *Framing* onward. It was not found necessary to perform a NGT on the Business Management process, however, some of the critical issues will require business managers, or in this particular case, R&D managers, to initiate the resolution or activities for prevention. Other recurring critical issues were believed to be under the group's control and influence. During the sessions and while discussing the origins of these symptoms and the leverage point for resolution the participants started filling the lower half of the posters (the area meant for the tools) with ideas for tools they wanted to use or procedures they needed to acquire to overcome or prevent the

issues to pop up again. This happened before the analysis of the current situation was finished and the next step in the process on improving the NPD-process was started. During the sessions it was also realised that the particular NPD-activities as we had originally categorised them, were not adequate for this specific company and we had to adjust and name some of them according to their terminology and workflow. The categories *Product Realisation* and *Production* were renamed into ‘Production equipment’ and ‘Production process’.

Overall, it can be said that the nested form of combining the discussion of the recurring issues, their origin and their point for resolution worked very well in this particular situation. All in all a fourth session was felt needed to complete the assessment and distil further actions and planning.

The learnings from this proof-of-concept are five-fold. First we learned that it worked fine to start with discussing the present NPD-portfolio. Second we learned that the especially the naming of the sub-processes and the activity categories might be situation specific. Thirdly, not all solutions proposed and chosen by the participants are considered to be NPD-tools. Sometimes it was just an adapted way of working that was needed to prevent the critical issues too surface. Fourthly, we realised that it is good to have a knowledgeable facilitator to guide the process. Finally and related to the 4th observation, there is no need to cast the procedures related to the use of the taxonomy in concrete. A contingent way of leading the sessions might be beneficial for creating support for the subsequent change initiatives.

4. DISCUSSIONS, OBSERVATIONS, LIMITATIONS & CONCLUSION

4.1 *DISCUSSING RESULTS: TAXONOMY AND METHOD OF USE*

4.1.1 *RESULTS TAXONOMY*

We have developed a taxonomy that overarches the total NPD-process, provides ample space to categorise the NPD-tools found in literature and is relevant to industry. The taxonomy covers four sub-processes that each knows a subdivision in *Management & Organisation* and *Activities*. Further decomposition in 10 categories was inspired by empirical data from the trenches of NPD, NPD-tools found in literature and the 7-S model of McKinsey. We more or less used all of the 7-S’s as categories. The S of Systems was decomposed in categories spanning all the value adding activities within that particular sub-process. During expert sessions, workshops and the final proof-of-concept it became clear that as a result of contingencies the taxonomy is flexible enough to allow for adaptations without needing to change the main structure of four sub-processes and sub-divisions. Adaptations that were necessary mostly concern the naming of sub-processes, or naming of the activity categories.

4.1.2 *RESULTS METHOD OF USE*

Regarding the method of application of the taxonomy to become an instrument aimed at innovating innovation, it was found that the proposed methodology seems to be applicable to many different kinds of organisations that develop products/services. In addition, we also found that it can be used at different levels of the organisation (levels of abstraction) as long as the names of process steps are flexible.

The names for the process steps should be defined during the first session, and in some cases redefined later. Although the four processes that we defined (*business management, front end, strict development, industrialisation*) are applicable to most

circumstances, it is important that companies work with process steps and activity categories that work for them and their level in the organisation, this could be more or less than the proposed four. As mentioned, the sub-division in Management & Organisation and Activities is generic and won't be subject to change.

During the proof-of-concept the portfolio discussion was very valuable to get to know the design of the taxonomy. It also synchronises the mind-set of the different participants of the session.

It was found, that people already add tools during the entire process and not only during the step in the methodology that focuses on improving the NPD process by selecting applicable tools. This did not cause any problems, and should not be discouraged, because they might not get identified again during the later stage.

Finally, regarding the use of the taxonomy by unskilled actors we can say that we still need to do some extra testing. Until now, a skilled and experienced facilitator is needed to guide the NPD-actors and stakeholders through the process.

4.2 OBSERVATIONS

The developed taxonomy including the tools provides an overview of the well-developed areas of the NPD process (those with a lot tools) and the poorly researched areas (with very little tools). The results show that academic research seems to fall short in addressing some major NPD-issues from practice. It was found that many of the issues, practitioners run into, are related to NPD and Business-management on one hand and the social dimension of the NPD-projects at the other hand. Comparably less symptoms are related to the design of the content that has to be created, while literature provides an abundance of tools that focuses on creating better products that users love to use.

Not surprising that several academics, looking at the sheets with all the NPD tools (Figure 1) remarked this imbalance. They proposed, independent of each other, the idea of applying the taxonomy to their academic research portfolio aiming to create a better balance and spread of their research programs across the overall NPD-process. Especially the white spots, being industry relevant areas with very little supporting NPD tools, draw their attention.

One particular problem area that was identified concerns collaborative activities across the interfaces with other, projects, departments and (internal) clients. These boundary-crossing issues dominantly surfaced throughout all steps undertaken in our research: during the case studies at the beginning, during the participatory design sessions and during the proof-of-concept. This observation made us wonder why so little research in the areas of NPD, design and innovation investigates the social dimension of innovation.

4.3 LIMITATIONS AND FUTURE CHALLENGES

By applying a design inclusive research approach we chose a very practice-oriented approach with high involvement of the users. Further research is therefore necessary to strengthen the taxonomy and to test its robustness, especially the position of the individual tools within the categories. In addition, more time should be spent gathering tools that are still missing in the taxonomy, mainly *management & organisation* and *interface activity* tools, to create an overview that is as complete as possible. Furthermore, we would like to make a further sub-division in the categories based on generic tool characteristics to further strengthen our taxonomy. We would also like to

gather more field data (symptoms) to add them to the model and to be able to build a database of all possible symptoms. The goal is to eventually digitalise the taxonomy including the tools to make it accessible to everybody. Finally, because there has so far only been one proof-of-concept we still need to create additional experience with applying the tool to various companies.

4.4 OVERALL CONCLUSION

With the taxonomy presented in this paper we are aiming at a perspective in addition to the existing perspectives that largely describes how to do NPD or how to become as good as the NPD-heroes (best practices). The perspective presented here is to improve the process and organisation of existing NPD-processes as well as to re-align the choice for specific NPD & design tools with the strategic direction and competitive position strived for. It therefore focuses on the (recurring) incidents that occur within or across product development projects and strives to build a company specific improved/innovated NPD-process and organisation with a selection of specific tools based on these incidents.

Looking back at our requirements we pretty much fulfilled them and ‘designed’ what we were looking for. Therefore we conclude that, the Innovation Management Canvas, consisting of taxonomy with four sub-processes and possibilities to link recurring critical incidents to solution areas is a promising meta-method that initiates relevant discussions within organisations aimed at innovating innovation.

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