

DEVELOPING NPD BEST PRACTICE THROUGH KTP INDUSTRY-ACADEMIA PARTNERSHIPS - A CASE STUDY OF HOWDEN

N. Fain, B. Wagner and Y. Liu

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1. Introduction

New Product Development (NPD) is seen as a source of competitive advantage by many established companies in the changing global business context. Despite many publications within the field, implementing an effective NPD process into their daily practices is still a challenge for many traditional manufacturing organisations [Laugen et al. 2005], [Kahn et al. 2006], [Markham and Lee 2013]. In order to address this challenge some companies have turned to the academic sector for support and are cooperating with universities in applying theory to practice. Knowledge Transfer Partnerships (KTP), a government co-funded programme has become an effective way of cooperation between academia and industry in the UK and businesses are increasingly establishing such pathways to develop their processes, products and services.

This paper reports on the initial stages of a KTP industry-academia partnership project, dealing with implementation of a bespoke New Product Development Procedure into a mature manufacturing company. It discusses best NPD practices in theory and addresses the challenges such a company may face in the process of implementing these practices into their own contexts. It contributes to the body of knowledge within the field of product development, by offering theoretical and managerial insight into how the context of the NPD process can be adapted to fit a traditional manufacturing context.

Accordingly, the main contribution of the paper is that NPD management approach as identified in best practice literature needs to be tailored to fit a mature manufacturing organization, where established operating procedures may be more resistant to change. For example, challenges in formalising the NPD process and setting up of product and portfolio management practices is largely influenced by product type, established operating procedures and levels of cross-functional cooperation.

2. Context

2.1 The company

Howden designs, engineers and supplies air and gas handling equipment, such as industrial fans, process gas compressors and rotary heat exchangers. Established over 150 years ago as an engineering company, Howden has grown to become a worldwide organisation with over 6,000 employees across 26 global locations. Howden's equipment may be found in various industries, for example in power generation, petrochemicals, mining, steel making and cement manufacturing.

Due to increased competition and evolving technology within their industries in the past decade, the company has been going through a cycle of changes, linked predominantly to establishing sustainable, repeatable and competitive product development procedures. This is aligned with their vision of becoming the leading application engineer providing lifetime solutions in air and gas handling. To achieve this, the company partnered with University of Strathclyde, Department of Marketing in a KTP project.

2.2 The project

The KTP project aims at developing a sustainable new product development procedure that will ensure timely and cost-effective delivery of commercially viable products to the market. The project has been divided into the following stages: (1) Preliminary analysis of the current state of NPD activities within the company, (2) secondary research on best practices in order to develop a pilot model of NPD procedure for Howden fan business, (3) testing and pilot implementation of the new NPD procedure within selected projects, (4) model optimisation, and (5) full roll-out of the model and procedure documentation to the entire Howden business platform.

This paper explores the first two stages and reports on the challenges encountered thus far.

2.3 The research approach

The research methodology for the purposes of this project has been twofold, theoretical and practical. A systematic literature review was performed, in line with Denyer and Tranfield's [2009] guidelines and this allowed for a structured mapping out of constructs relevant for NPD and informed the development of an in-depth interview protocol. The main constructs derived from the literature review were prioritised as: market intelligence [Griffin and Houser 1993], [van Keef et al. 2005], [Bonner 2005], product management [Page 1993], [Griffin and Page 1996], portfolio management [Copper et al. 2002], [Kester et al. 2011] and structured NPD process [Cooper 2001], [Sivakumar and Nakata 2003]. The glue integrating them into an effective practice is cross-functional cooperation throughout the full process [Page 1993], [Griffin 1997].

The interview guide was derived from these key themes and was based on semi-structured questions focusing on project characteristics, NPD process, organisation and portfolio management, decision making and performance metrics [Griffin 1997], [Kahn 2006], [Kester 2011] within the company. 10 interviews were conducted with key stakeholders within the company, including the project manager, marketing manager, production design and development manager, chief engineer, general sales manager and technology director. The length of the interviews ranged from 30 minutes to 2 hours and resulted in around 100 pages of transcripts.

Secondary research, using company reports and operating procedures complemented preliminary data gained through these interviews. The combination of such techniques enabled examining current state, matching the empirical data to cutting-edge theoretical developments and proposing a suitable framework for the company.

3. Theoretical developments in NPD

As indicated above, the systematic literature review has identified four themes as key to achieving effective NPD: market intelligence, product management, portfolio management, structured NPD process and cross-functional cooperation throughout the full process. These themes will be further discussed below to inform the theoretical framework for NPD management proposed, and guide the preliminary analysis of state-as-is within the company.

3.1 Market intelligence in NPD

One of the barriers to NPD success is an organisations inability to capture and interrogate market information. However, many do not know what kind of customer information they ought to be collecting and do not have the skills or formal processes to capture the correct information [Flint 2002]. Using formal procedures in the NPD process increases the chances that market opportunities for the new product will continue to exist when the product has been developed. Understanding

customer's current and future needs reduces risk and such knowledge is very helpful in developing future products. Some scholars suggest that customers are unable to predict what they will require; nevertheless formal and comprehensive procedures for understanding the customer will help to clarify the front end of the NPD process and produce more successful new product ideas [Flint 2002]. Organisations that operationalize market knowledge may be better able to more efficiently realise its technological capability than its competition by identifying innovative product features desired by the market [Li and Calantone 1998], [Khan et al. 2006]. Maintaining an overall market orientation will ensure customer satisfaction and customer acceptance. Market research that is used in a systematic and coherent way will act as evaluative criteria throughout the entire NPD process. In so doing managers will be familiar with the needs of the customer throughout NPD initiatives [Tzokas et al. 2004]. NPD can be categorised into a number of high level organizational decisions, namely, concept development, supply chain design, product design, production, ramp-up and launch. Early concept development decisions are crucial as they help define the product specifications, physical configuration, potential product extensions and also after-sales supplies. Within these decisions consideration must be given to speed, price, reliability and capacity. These decisions require complete understanding of customer's current and future requirements [Kirschnan and Ulrich 2013]. As suggested by many scholars, a major cause of new product failure is the lack of fit between customer requirements and new product attributes [Van Kleef et al. 2005]. Several tools, such as the House of Quality can be used as an organizing framework to visualise the relationship between product attributes and customer requirements, focusing on design trade-offs and highlighting competitive shortcomings [Schilling and Hill 1998]. A deep understanding of customer needs in the early stages of the NPD process may allow developers to go further in anticipating customer future needs [van Kleef et al. 2005]. In this sense market intelligence activities in NPD that capture the voice of the customer may be considered a strategic resource [Stank et al. 1997] advancing organizational competence [Li and Calantone 1998].

3.2 Product management

An effective product management process is beneficial to a company's NPD performance, as it guides the decision making about the product throughout its NPD life cycle. It involves the activity of making Go/Kill decisions at NPD gates under systematic criteria, i.e. success measures [Hart et al. 2003]. Success measures for individual new products are a fundamental aspect for better understanding each new product. Overall, there are three dimensions of measures: market/customer dimension, financial dimension, and product dimension. Effective success measures vary depending on the types of new product [Griffin and Page 1996]. Six different types of new products are identified [Cooper 2001], according to two "newness" dimensions (i.e. newness to the company and newness to the market). Literature has suggested the most effective measures with regard to the "newness" dimensions for different types of new products include market share, competitive advantage, customer acceptance and satisfaction, and met profit goal [Griffin and Page 1996]. These measures are relevant for the product to be evaluated and managed from the initial idea throughout the NPD life cycle.

3.3 Portfolio management

Portfolio management integrates the products into an effective portfolio and helps to assess the optimum portfolio mix and appropriate split between high and low risk projects/products. It views each NPD project as an investment, and attempts to apply portfolio management techniques to manage these investments [Edgett 2011]. Key activities include strategic alignment of resources, the selection and prioritization of high value projects (and killing the poor ones), ensuring that there is the right balance and mix of projects in the portfolio, and balancing the limited resources available against the demand to do even more projects. There are three major goals for NPD portfolio management [Copper et al. 2002]: (1) maximize the value of a portfolio through financial performance, (2) achieve a balanced portfolio by using methods, such as bubble diagrams and customer needs profiles, and (3) develop a strong link to strategy. This final goal requires that all active projects are aligned with the business strategy and they actively contribute to achieving the goals and objectives set out in the strategy. This ultimately means all resource allocations across business areas, markets, and project

types are aligned in order to truly reflect the desired strategic direction of the business; the mission, vision, and strategy of the business must be operationalized in terms of where the business spends money and which development projects it undertakes.

Although much emphasis has been put on NPD portfolio management recently, benchmarking evidence suggests that most businesses still have a long way to go in terms of implementing best practices and achieving the desired results from portfolio management [Edgett 2011].

3.4 Structured NPD process

Full integration of the above mentioned practices goes hand in hand with a structured NPD process. NPD is defined as a process of conceiving, creating, and launching a product new to the company, a market or the world [Crawford and Di Benedetto 2003]. It typically involves collaboration among scientists, engineers, industrial designers, market researchers and others [Veryzer 2005]. The key phases in the process of NPD as presented by marketers are initiation, which covers idea generation, screening and concept testing, and implementation, which includes product design, test marketing and market introduction [Sivakumar and Nakata 2003]. Engineering experts however dissemble the proposed scheme into several more phases in order to get a systematic approach towards product innovation. One of the engineering-based views on NPD divides the process into stages according to the department within the company, where the activities should take place (figure 1).

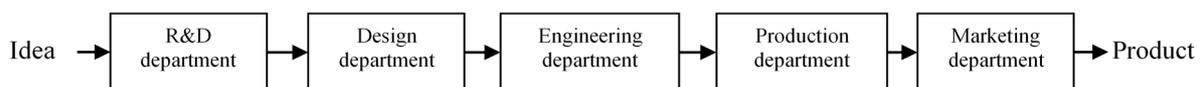


Figure 1. Department-based view on NPD [Buijs 2003]

Cooper's Stage-Gate process is the most widely used framework for structured NPD, as it incorporates both functional views and aims at suggesting practices, roles and responsibilities throughout the full NPD process. It is a "conceptual and operational model for moving a new product project from idea to launch" [Cooper 2001:129]. It breaks the innovation process into a predetermined set of stages (i.e. discovery, scoping, building the business case, development, testing and validation, and launch), each stage consisting of a set of prescribed, cross-functional, and parallel activities. The entrance to each stage is a gate, which controls the process and serves as the quality control and Go/Kill checkpoint. The process is presumed to adapt as the company evolves, thus the third-generation Stage-Gate process further distinguishes six fundamental features each NPD procedure should have [Cooper 1994, 2001]: (1) *Flexibility*. Stages can be omitted and gates combined according to the project's specific risk level and needs. The risk level, the uncertainty, and the need for information dictate what steps and stages need to be done and which can be left out; (2) *Fuzzy (conditional) gates*. Go decisions can be conditional on anticipated future events occurring; (3) *Fluidity*. There is an overlapping of stages. Activities are not fixed to specific stages. The next stages begin before the last is complete in order to accelerate the process. It goes hand in hand with the idea of fuzzy (conditional) gates; (4) *Focus (project prioritization and portfolio management)*. The focus is moving to effective portfolio management. One manages not just the merits of the project under review, but an entire portfolio; (5) *Facilitation*. A process facilitator, process manager, or process keeper is employed to ensure that gatekeepers follow the rules of the game and that a decision is made; (6) *Forever green (always regenerating and improving)*. The processes are being constantly renewed, redesigned, and improved as user-companies gain experience with this approach.

These features omit the robustness and the prescriptive nature of the earlier generations of the stage-gate process, with the aim of making it applicable to all types of products, from incremental to radical innovations.

3.5 Cross-functional cooperation of stakeholders

The need for effective functional cooperation within NPD processes has been widely recognized in modern business environments due to ever changing requirements of fast growing markets. Despite extensive publications in this area, very few companies have actually succeeded in achieving the

optimum levels of such cooperation. That is particularly noticeable in established technology companies that are involved in business-to-business (B2B) relationships with their stakeholders. In such companies the gap between functions, such as R&D and marketing has proven still to be very significant. As Barczak et al. [2009] have found in their Product Development Management Association best practices study the practice of how NPD teams are assembled, trained, enabled, supported and managed is not consistent with recommendations from published research on topics such as R&D-marketing interface and NPD team performance. Furthermore, they note that “additional research on developing effective NPD strategies and on integrating NPD strategy across levels of the organizations would be useful, with potentially powerful outcomes” [Barczak et al. 2009].

Several papers have reported on managerial implications of good cross-functional cooperation and scales have been developed to study the levels of cooperation needed and achieved [i.e. Lu and Chang 2002], [Song and Thieme 2006]. Furthermore, the effects of cultural differences on NPD performance and cross-functional cooperation have been analysed and different approaches towards integration for different NPD stages proposed [for a literature review see Griffin and Houser 1996].

Early studies such as those of Ruekert and Walker [1987] and Song and Perry [1993], identified integration factors important in different stages of NPD and linked the cross functional cooperation to NPD success. Furthermore, some studies actually determined in which areas of NPD a specific function needs to be more involved, and where the cooperation/integration of functions is most needed, for example Olson et al. [1995].

Song and Thieme [2006] further developed testable hypotheses based on Gupta et al.’s [1986] work and highlighted similarities and differences in cross-functional involvement between functions in NPD across three countries. For the purposes of identifying the size of the cross-functional gap and the integrative mechanisms that are most influential within the integration process in NPD, the mentioned studies prove to be very useful, as they provide validated scales to examine and quantify the studied variables.

They further provide valuable propositions related to aspects managers need to consider when dealing with cross-functional cooperation within NPD. As Gupta et al. [1986:14-15] conclude: “by conceptualizing integration in terms of the degree of R&D-marketing involvement and information sharing in the various stages of innovation process, these managers can better understand their own role and the role of the other group”. The framework is therefore useful for determining the state-as-is within companies and identifying potential areas of improvement. In accordance with the key themes identified in literature, a conceptual framework of NPD management is proposed in the following section.

4. The conceptual framework

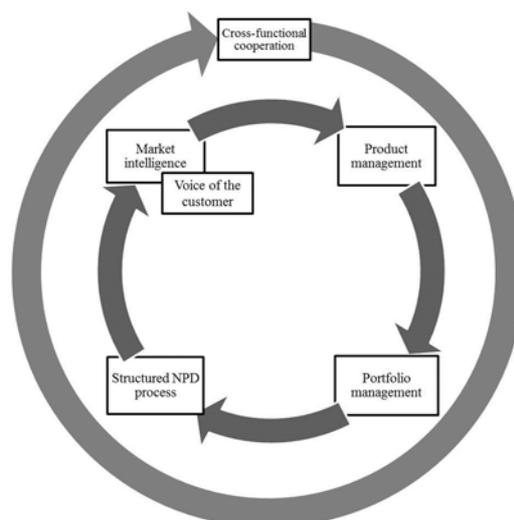


Figure 2. NPD management framework

Following Cooper's [2001] third generation framework for NPD that presumes flexibility and fluidity of stages and cooperation, it is proposed that the four identified themes, i.e. market intelligence in NPD, product management, portfolio management, and structured NPD process, consist of a cycle and interact with each other through cross-functional cooperation. Market intelligence captures customers' requirements and needs and helps generate new product ideas. Effective new product management is required to measure and track the new product performance based on the type of product. Portfolio management goes beyond managing a single product to selecting and prioritizing products, and ensuring a mixed structure of different types of product and a good balance between products and resources. Together with the input of market intelligence, effective product management and portfolio management, a structured NPD process could work to achieve the best NPD performance. The high engagement of customers in the NPD process will provide a feedback loop to market intelligence, improving the customer input. Importantly, cross-functional cooperation enables high levels of integration among different functions and makes the whole cycle run smoothly and efficiently. The cross-functional cooperation also improves throughout the whole cycle.

5. Preliminary analysis of current state in Howden

The outlined framework served as a guideline when situation analysis was performed in the company. Key stakeholders were interviewed and the four key themes, supported by cross-functional cooperation were analysed. The preliminary findings are discussed in this section, followed by a set of implications for theory and practice. Challenges arising are outlined and possible solutions discussed.

5.1 Market intelligence in NPD

Market intelligence that includes VOC has been identified as a key component of a successful NPD procedure in literature. However, not every company successfully integrates market intelligence into their NPD procedure. The current situation in Howden is that the new product ideas are predominantly generated at formal review meetings, followed by an initial list of priorities. This idea generation process may result in new products that only serve niche markets, thereby limiting the scope of innovation in the company.

Although supported by informal sales input, one of the interviewees recognises that "*voice of the customer has, for most part, been ignored.*" He further emphasises that for the fan project the VOC was "*driven internally*". The company has recognised this and as indicated by another interviewee "*has taken on a formal exercise in establishing structured processes of capturing VOC.*" This is in line with the market intelligence literature, that stresses VOC should be an integral part of the front end of the NPD process [Van Kleef et al. 2005].

Furthermore, there appears to have been limited cross-functional cooperation in the company, as "*there was no marketing presence on the steering committee.*" Again, this has been recognised by the company, and there are now representatives from supply chain, marketing and finance integrated into the team. As seen from these findings, there has been a gap in the relation to best-practice NPD as outlined in literature [Gupta et al. 1986], however it has been addressed and is currently being implemented into company practices: "*We feel it would be better if someone outside of the current process, outside of the normal contacts were addressing some of the questions that we need to get answered.*"

In the preliminary analysis of market intelligence in the company, the findings show two improvements that are on the way: (1) Historically the VOC process has been informal in the company, thus a formalized procedure needs to be implemented and (2) involvement of marketing in the initial NPD stages has been limited.

5.2 Product and Portfolio management

Currently, the company does not operate formal product and portfolio management. Go/Kill decisions for each project are made at the review meetings within the R&D Department and further reported at formal meetings. Judgment is based, primarily, on the experience of senior engineers within the business. It is recognized that formal, systematic criteria for these decisions are required. Furthermore, as one of the interviewees indicates "*we have had quite a few areas where we have started to work*

and discovered we can't really change anything. And we basically move on to something else, take the next idea and go forward with that." This can be considered a gap with regard to portfolio management best practice literature that states that having a balance between projects undertaken and the resources available at any time is necessary for NPD efficiency. Furthermore, as Edgett [2011] outlines there is a need for evaluating high value projects, that are profitable and with solid commercial prospects. As the above quote shows, this is not currently standard practice in the company, but as the interviewee further elaborated "*this is what we are trying to establish*", indicating the company's awareness of the importance of project and portfolio management.

Informally, the company has already started to adapt product management through implementing Go/Kill criteria into their review processes: "*that's why we build milestones into the design assignments. In the review process, if it is not going anywhere, we may say, 'ok, we will give it another couple of weeks to see if we could get it to move forward'. If not, we discuss other possible aspects of improving the development. This can lead to 'Eureka' moments or decisions to terminate and move on.*"

In the preliminary analysis of product and portfolio management practices in the company the following challenges have been identified:

- Product and portfolio management practices are rather informal in the company, and this may limit innovative capabilities.
- Portfolio management practices are not interlinked with products.

5.3 Structured NPD process

Although the company conducts NPD activities, most of the activities are undertaken in a relatively informal way. The NPD process has not become business-as-usual. The NPD activities including idea generation, development, and review points are predominately driven by individual projects and are not standard practice. Idea generation, for example has been limited to a single workshop, resulting in prioritizing ideas: "*There was an idea generation workshop that took place with representatives of most of the business units, and supply chain as well. There were like 300 ideas identified, which were then ranked in order of priorities and impacts.*" This forms a gap in relation to best practice literature that indicates there needs to be a structured NPD process in place to guide product ideas [Griffin 1997] and reasonable balance among projects in the sense of newness of the product (i.e. new to the world; minor developments; incremental product improvements) [Griffin and Page 1996], [Edgett 2011].

The preliminary analysis in the company therefore shows that it is essential to include a documented, clearly defined, and yet adaptable idea to launch NPD process.

5.4 Cross-functional cooperation of stakeholders

Apart from customers, engagement of other stakeholders (e.g. marketing, sales) throughout the whole NPD process is important. Howden aims to have a cross-functional structure for engaging in NPD projects. However, as one of the interviewees mentioned, "*It is quite a dynamic thing... Basically you bring people when you need them.*"

Cooperation and information exchange is not strong enough under such a structure. It will bring issues. As one of the interviewees said, "*Manufacturing won't know what to manufacture. Sales and marketing, what happens to them? Do people have a forward view of where they want to go with their products?*" Ensuring engagement of all relevant stakeholders throughout the whole NPD procedure is seen as critical in best practice literature [Page 1993], [Griffin 1997], but is currently not given high enough priority in the company.

In the preliminary analysis of cross-functional cooperation practices in the company the following challenges have therefore been identified:

- Cross-functional cooperation is limited to some activities, but does not engage all relevant stakeholders throughout the whole NPD process.
- Information exchange is predominantly informal and based on stakeholder's good will.

Based on the preliminary analysis and identified challenges, a revised NPD management framework was developed for the company, as shown in Figure 3.

6. Revised conceptual framework for Howden

Combining best practices in theory with the characteristics defined through company research indicate that for the purposes of the company, the theoretical framework needs some revisions.

Through the interviews with the key stakeholders it has been identified that informal procedures are mostly in place and achieved under the overarching umbrella of cross-functional cooperation. Opposed to the theoretical implications that cross-functional cooperation is a characteristic of NPD, the research has identified it as a key driver for projects extending beyond business-as-usual engineering practices.

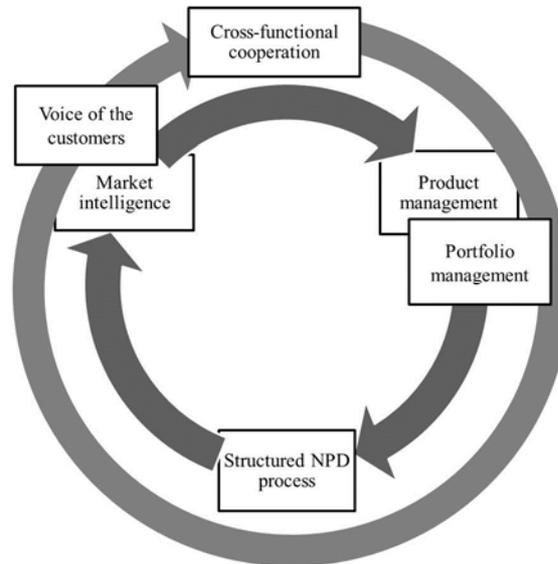


Figure 3. Revised NPD management framework for Howden

Voice of the customer represents a cross-functional activity as opposed to being positioned only within market intelligence. Similarly, product and portfolio management are discussed separately in literature, whereas the researched case highlights that even at an informal level, they need to have a strong interrelationship in order to truly reflect desired strategic direction of the business.

The research however finds support for Coopers' third generation NPD process [2001], as it relies heavily on the overlapping of activities relevant for NPD.

7. Conclusion

The purpose of this paper was not "reinventing the wheel" within the field of new product development processes, but to show how established practices can be combined with academic knowledge and theoretical frameworks to achieve growth and profitability and to outline that there are challenges that arise from doing so. The paper reports the initial stages of a KTP project involving University of Strathclyde and Howden, reviews the best NPD practices and identifies gaps in a traditional manufacturing company's NPD practice. Based on these, a framework is proposed to help the company successfully implement best practices. As shown in the revised conceptual framework (figure 3) business phenomena such as market intelligence, portfolio management, functional integration and NPD cannot be analysed as separate variables, as they are all part of and contribute to the final NPD effectiveness.

The contribution of the paper is threefold.

First, theoretical frameworks have proven to be useful to determine the desired state and direction the company wants to go, but the procedures need to be developed purposefully to fit the needs/culture/environment of the company.

Second, cross-functional cooperation is the umbrella construct, integrating effective NPD management. Within this, the framework illustrates that product and portfolio management cannot be

considered as separate activities and need to be concurrently managed to ensure best NPD performance.

Finally, market intelligence needs to be an ongoing activity, with particular emphasis on engaging with the VOC in order to facilitate early stages of NPD management practices. Although aiming at identifying and upgrading a certain spectrum of business, such as NPD procedures, one must carefully consider other relevant business processes, such as lean and continuous improvement, along with the culture of the company. Integrating all of them into a structured project enables full involvement of key stakeholders and understanding of the procedures the company operates and thus gives a greater chance of success.

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Dr. Nusa Fain
University of Strathclyde, Department of Marketing
Sir William Duncan Building, 130 Rottenrow, Glasgow G4 0GE, UK
Email: nusa.fain@strath.ac.uk