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THE ROLE OF DEVICES IN STAGING FRONT END INNOVATION

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ABSTRACT

This paper addresses Front End Innovation as an object for the management and staging of innovation processes. We examine the role which devices play in the managing of Front End Innovation, with inspiration from Science and Technology Studies (STS). The paper contributes to a new understanding of the staging of innovation processes, which focuses on the content and framing of ideas at the front end. The understanding sensitises hereby towards concerns of path-dependency and translations, including trade-offs and potentialities involved in sustaining or reframing matters of significance as part and parcel of the innovative process.

The paper is grounded empirically in insight derived from industry practices and compares practices to current literature on the management of innovation, which portray Front End Innovation as a mere process of search and selection of product ideas. The paper examines a range of such front end devices such as the 'idea-bank' and 'front -end champions', discussing how particular devices serve to configure heterogeneous networks to in some respects facilitate, while in others, hamper, the productive engagement of the networks in the mobilisation of ideas and visions into realisations.

Inputs from different knowledge domains must be grappled with, both in terms of needing to be elucidated as well as synthesized, in the engineering design process. The paper argues that the existing research may be seen as a response to perceived difficulties in dealing with uncertain conditions in the innovative process of product development. The sole reliance on formalised models of planning, and rigid Stage-Gate models for product-based innovations in industry is seen to be wanting in this pursuit. What remains unaddressed is the role of models and other devices such as representations of users or market and technological opportunities in the innovative process. In this respect, models are not neutral but offer certain framings, contribute translations and act as sensemaking devices.

INTRODUCTION

The need for more radical innovation and attentiveness towards the importance of working with insights and ideas from a variety of sources has attracted considerable attention. The trend is indicated in the growing academic literature as well as more practically-oriented internet forums, and ongoing experimentations and exchange of views and experience among practitioners across industry under the heading of Front End Innovation (FEI). The tendency reflects a general

debate about the need and possibility for enhancing industry capabilities, being able to take on board a diversity of perspectives from emergent technologies, governmental regulation, potential markets and new innovative competences and organisational schemes. The new focus on FEI can be seen as a response to shortcomings of relying solely on formalised models of planning, and rigid stage-gate models for product-based innovations in industry. A response, which reflects perceived difficulties of dealing with uncertain conditions in the innovative process of product development in a fruitful manner.

The objective of this paper is to address Front End Innovation as an object for the management and staging of innovation processes. More specifically, we examine the role which devices play in the managing of FEI, with inspiration from science and technology studies (Actor-Network Theory and the notion of boundary objects). Drawing on the notion of "devices" as elaborated by Muniesa et al. [1] in their work with heterogeneous assemblages of intervention in the construction of markets, we examine and discuss devices that intervene at the front end.

By addressing the role of devices the paper contributes to a new understanding of the staging of innovation processes. We expect the use of devices to play important roles in the configuration of spaces for interaction between a diversity of ideas and knowledge at the early, 'fuzzy' stages of (product) development, yet also with ramifications for the ensuing, somewhat more structured, activities and engagements of firms and organisations, at the 'market end'.

These are processes which potentially question or define a range of taken-for-granted assumptions concerning issues of product/service, customer/users, firm identities, and the like. This new understanding focuses on the content and framing of ideas and sensitises towards concerns of path-dependency and translations, including trade-offs and potentialities involved in sustaining or reframing matters of significance as part and parcel of the innovative process.

The 'front-end' of innovation seems to reveal itself as an interesting and contested terrain where company product development strategies and visions for future products are currently challenged and reframed. Control and management of these emergent processes are not easily stratified like in the stage-gate controlled part of new product development.

Whether technology-driven or more anthropologically informed market-oriented approaches, New Product Development at the early Front End

of Innovation potentially involves inputs from different knowledge domains which must be grappled with. A range of challenges are expected to be met and resolved, both in terms of their needing to be elucidated, as well as synthesized, in the engineering design process. We argue that existing research may be seen to be wanting in addressing the issue of how formalised models such as the Stage-Gate and practices on which these are based, work with ideas for new products and services in identifying and ordering issues of relevance as part and parcel of the management of innovation processes.

CURRENT APPROACHES

Recent research within the management of innovation at the 'front end' has been characterised by a variety of approaches. A prominent focus has been on the development of tools for management of knowledge-synthesis relating to markets, technology and strategy [2,3]. These contributions point at the limited capacity of linear stage-gate models within the so-called New Product Development, when it comes to innovation, and especially, the quest for radical innovation in a business perspective. This stream of research is (like much NPD research and development) rather model oriented, and claims to present 'best practice' suggestions based on empirical grounds. Koen et al [2] present a new model on 'New Concept Development' which emphasises the role of interactive and feedback processes in working with product ideas, in contrast to the linear ideas embedded in stage gate based models of the New Product Development. It is within this operation-oriented stream of research that the new innovative space has been named 'the fuzzy front end of innovation'. But even so, the main reference is still the extension of a stage-gate model approach to the product development process, and, as such, reproduces elements of the linear thinking in line with the models of how to organise the processes of search, selection (decision-making) and implementation that are concerned with product-ideas as illustrated in the textbook of Tidd and Bessant [4]

In the domain of innovation practice, a new approach characterised as 'connect-and-develop' (based on undertakings at Proctor & Gamble) has drawn attention to a reorientation towards how innovative ideas come to realised, or how resources, with elements both company external as well as internal, are mobilised in the process, to augment company internal capabilities. The

changing of the innovation landscape and the roles played by SME's, industry partnerships involving university and government managed endeavours, and more generally, practices of open source innovations, render the connecting of ideas across company external businesses and competencies an increasingly important part of the innovation paradigm for the firm itself [5]

The main preoccupation with this reorientation concerns the conscious trial-and-error processes that such an innovation entails in the face of uncertainty, while being sustained through a company-wide strategic orientation and attentiveness to company external environments. The concern to seek outside the company (or company R&D) hinges upon the idea that the potential for innovation resides not within firm boundaries (or across its departments) alone. Such a consideration towards innovation as a distributed, and hereby also a collective, endeavour (i.e. across boundaries, be it company external or internal), makes it subject to management but also to a study of how such management takes place, as part and parcel of how ideas are grappled with in the innovation process. In so far as innovation is a 'matching process', it entails the unravelling an interweaving of ideas, competencies, and techniques, through exploration and exploitation [6], evoking in such boundary spanning relationships knowledge practices untapped in the firm [7].

In this sense, a challenge in FEI may be, as in innovation processes altogether, as to how the nature of ordering and (re)organisation may be construed altogether. The firm enacts and translates ideas and competencies within and across firm boundaries, and undertaking that must at the same time be seen in the light of issues of path-dependency and sustained market positions.

While these 'main stream' approaches identify and label processes, they fail to analyse the practices of these processes and ignore the role of actors and politics. Other approaches to understand idea work and 'front end innovation' can be found in research concerned with political processes and sociotechnical dimensions in organisations, in terms of how these come to bear upon the work with ideas and how ideas gain currency in the context of the organisation [8-12].

Regardless of approach, what remains unaddressed is the role of these models and practices in the work with ideas for new products and services, as they come into being and are configured. In this respect, models are not

neutral but offer certain framings, contribute translations and act as sensemaking devices.

The paper is grounded empirically in insight derived from industry practices and compares practices to current literature on the management of innovation, which portray Front End Innovation as a mere process of search and selection of product ideas. The paper examines a range of such front end devices such as the 'idea-bank' and 'front -end champions', addressing issues of path-dependency and challenges of staging innovation processes with such devices. The paper discusses how particular devices serve to configure heterogeneous networks to in some respects facilitate, while in others, hamper, the productive engagement of the networks in the mobilisation of ideas and visions into realisations.

DEVICES AND ENACTMENT

As a first step, we draw upon the notion of *devices* from Actor-Network Theory (ANT) in Science & Technology Studies (STS). Here it has been used, amongst others, in early, so-called *laboratory studies* of techno-scientific practice, which have dealt with how scientific phenomena are rendered visible through the 'making of traces' or inscriptions, in the course of their transformation into ever more stabilised forms. These transformations occur at the price of *deleting* (or 'bracketing') the original contingencies of their production, in turn, making the traces, thus made manifest, generalisable and increasingly manageable, albeit always in a state of tension, owing to the selectivity of how they re-present the phenomenon in question. The notion of devices, as a sensitizing concept, is an analytical means to draw attention toward the circumstances of such translation of phenomena, i.e. a mindfulness as to the assemblage of the "particular combination of machines, pieces of apparatus and technicians," [13], so heterogeneously arranged. This makes devices far from neutral objects. Rather, devices are to be examined, as particular means of intervention and ordering – or even strategies – which translate and reconfigure the phenomena itself in question, in terms of the very workings of the *device* vis-à-vis the broader, albeit contingent, network of relations of which, it is part and parcel.

In terms of the analytical treatment of devices, two aspects, while not entirely absent in this early work of Latour and Woolgar [13], has been made more explicit in recent works. Specifically in the STS scholarship pertaining to the study of markets, a similar notion of *devices* has been

engaged, elaborated and developed to address the objects, material and discursive, which intervene in the construction and workings of markets. Muniesa et al. [1] puts forth the element of agency with respect to devices, and how agency in this light entails not a set of pre-defined sets of interaction among persons and objects, but a collective *agencements*. These authors note: "It is only when devices are understood as agencements that the evolving intricacies of agency can be tackled..."[14]. They bear open the idea of exploring how products, services and market actors are framed, and undergo translation and displacement through reframing and qualification as part and parcel of the enactment of devices. The other aspect concerns explicating the repertoires of knowledge that enter into the workings of devices, and how different knowledges are tied, differently, to the enactment of devices. The notion of devices may be conducive to localising, not where, but how knowledges are found, enacted through various translations and stages of the organisational processes implicated in organisational practices of innovation and activities at the Front End, more specifically. Through these elaborations on difference – on the issue of agency and knowledge, their distribution and collective enactment – the present paper engages the notion of devices for the staging of front end innovation.

Actor-Network Theory would point that the translation of knowledge from a variety of sources takes place as a main process in the constitution of a product idea generation. Knowledges are configured, stabilised, and facilitated (explicitly or otherwise) to give particular meaning, through particular heterogeneous enactments and collective mobilisation of resources. Multiple instances are involved, where a variety of conflicting interpretations of problems and solutions by a multiplicity of actors may be at play. The notion of devices draws to attention the localisations of agency, and thus also the embedded and distributed nature of agency in the translation and mediation of the tasks and goals which entail innovation in product development. This leads to a question of whether and in which capacity and meaning these translations can be managed and how they contribute to the constitution of innovation and product design with its specific inclusion and exclusion of the content of ideas.

Companies' reliance on implicit and emergent strategies to guide their identification and management of substantive aspects of their idea generation activities as well as their subsequent

selection and translation into new product development processes, seems to point to a lack of explicit questioning in management about how existing practice as well as emergent (technological) trends, render themselves relevant (conducive or challenging) for new product development and innovation in and for the company. Identifying the possibilities for 'staging' of front-end innovation processes and coordinating activities, through the idea that devices configure and reconfigure definition and redefinition of boundaries, the mediation of interests and agency, as well as the bridging of diverse spaces as processes of translation and network building are possible, but also very much a challenge and a resource that may be drawn upon.

A pair of notions which helps to facilitate an understanding and enactment of such coordination – and productive means of channelling and managing differences or contestations, is that of boundary objects and sensemaking. The concept of boundary objects point to how different knowledge domains, which may be seemingly without relevance to one another, or even contradictory and in tension, can be facilitated despite such differences. A new way of seeing and interacting, a form of collaboration spanning boundaries of knowledge and practice, is actively and gradually developed, through the identifying or generating of a shared repertoire of objects within their collaboration [15-17]. Based on an understanding of the accomplished character of knowing, involving (collective) sensemaking within and across social worlds, sensemaking is an active process occasioned, incidentally or prompted intentionally, through disruptions in taken-for-granted routines, norms and forms of interactions [18]. These, in their respective ways, draw on the ideas of commonality and differentiation, and how these might be engaged productively in transforming knowledge and practice. They allow knowledge to take on a productive, relational and emergent dimension, based on action which may potentially lead to shifting power relationships in the mutually constitutive character of knowledge with practice, see also Bijker [19].

Through boundary objects specific knowledge contributions are translated across these domains and, in doing so, selectively transform the scope of relevance the individual, and the collective domains have, through making their collaboration, and the role of the individual knowledge domain in the collaboration, meaningful. In innovation differing requirements may

manifest throughout the course of the ideation, product development or product life processes, where diverging sets of concerns need to be managed. These are issues which may productively addressed already at the Front End of innovation, where issues of sensemaking and bridging of knowledge and concerns through the facilitation of boundary objects, may be construed as part and parcel of the innovative mindset. Rather than relegating innovative processes to established forms of interaction between organisational units and external institutions, these notions can challenge the form of interaction and knowledge elements that may augment relevant knowledge flows and competence building from the early stages of innovation.

DEVICES AS KNOWLEDGE OBJECTS

In the following a number of devices often met in company practises are presented indicating how the 'front end' is practiced as a space where established and rooted strategies and conceptions continuously are sought to be challenged. These devices are revealed as the outcome of researchers' dialogue with company professionals in a number of workshops on FFI and expresses practical attempts to deal with shortcomings in current management of innovation approaches.

Idea boxes. Most companies have established a mechanism allowing organisation members or even outsiders to post ideas in an idea box. The idea with this device is to attract suggestions from people normally not professionally engaged in idea generation and to enable by-passing of the established management structure. Idea boxes may be demand more or less structured proposals and more or less standardised formats of presenting ideas. The system would also consist of a scheme for evaluation of the quality of the suggestions and a mechanism for connecting ideas to relevant parts of the organisation and the creation of pathways for investigating potential implementation. In many cases these systems are reported as working supplementary channel for idea generation. But, the working of this kind of device depends very much on the institutional framework is embedded in:

- the format for standardisation of idea description and characterization and the established ways of communicating ideas in the particular organisation
- the competences of the evaluation committee and the political 'filters' it represents, i.e.

depending on whose and which perspectives are allowed into the evaluation

- the mechanisms for relaying ideas to create new organisational connections.

The lack of direct communication hinders fruitful interaction between people suggesting ideas and the qualifications asked for by the evaluators. The risk is that the box will be working more like a storage or bank than a mail box for communication and that the ideas are not easily aligned with strategic interests of the company.

The 'front end champion'. Here the device is a formal organisational creation of a new role in the innovative process. The 'front end champion' is intended to work as a shortcut circumventing the established and previously formalised procedure of selecting innovative ideas for further investigation, exploration and eventually implementation in the organisation. Compared to the idea box, the 'front end champion' is a device actively engaged in the search and selection process which can offer a much more interactive mode of working. In one case the 'front end champion' is seen as a solution to the problem of the path-dependant nature of the established networks of customer collaboration and knowledge exchange. The 'front end champion' is equipped (by top senior managers) with the authority to pick ideas from individual members of the organisation and bring these directly to senior managers attention having an eye for potential discontinuous innovative ideas. The translation of existing stabilised networks appears here as the potential outcome of challenging formal selection and portfolio management, formal budgeting processes and established key performance criteria.

Project definitions. An important game in the organisation is to secure resources and working space for specific types of development projects that are allowed a longer time horizon and less constraining short term business criteria. Company practices have increasingly been creative in defining new type of projects that explicitly deviate from the stage gate controlled NPD project templates and manuals. Examples include the creation of new concept development departments or units being assigned the task of carrying out idea work with an open problem statement and experimental mode of working. A real challenge is here how to make such an organisational device aimed at radical innovation work co-exist in an organisation which also have to take care of day to day business and meeting short term business demands.

In many engineering oriented companies long term development projects are defined as technology development projects as it is well recognised, that uncertainties in new technical solutions have to be resolved before the NPD process is initiated. But, interestingly, the same cannot be said about defining projects for investigating or resolving user, market or business oriented knowledge if the company is technology driven. In this case, the definition of possible projects including project guidelines and manuals is an important device for opening up other pathways than the traditional technology pathway. Alternatives may be user pathways providing space, resources and time for exploring use and user knowledge or business pathways for exploring business opportunities.

CASE: THE ALPHA PRO CIRCULATOR

The development of the Alpha Pro circulator is here taken as an example of a device enabling the reframing of what constitutes an 'energy saving pump'. The case is adopted from Gish, Hansen and Clausen [12] while the specific presentation and interpretation here is on our own account. The Alpha Pro circulator is a circulation pump for use in heating systems developed and manufactured by Grundfos, one of the world's leading pump manufacturers, based in Denmark.

The development of this particular product illustrates the role and importance of the front end of innovation as long as the development of this specific product idea spans over a period of 20 years (1985-2005). It starts out with the identification of a couple of promising energy saving technological solutions: the development of a new motor control enabling a considerable increase in pump efficiency. This was first seen as an opportunity for materials (and cost) saving in continuation of already established ideas of pump development. Later the focus shifted towards a broader development of a new motor technology platform based on permanent magnetization. The interesting point is here, that the idea work continued as 'front end' activity while several specific products based on these product ideas were launched through the established stage gate process. This observation illustrates the so-called 'front end' activities better can be understood as a recursive space for idea work including reflections over market successes and failures in occasional product launches, rather than a 'fuzzy', early phase, of an otherwise structured process of innovation which is otherwise well-delineated. And in this case market success did not co-evolve with the

successful technological solutions. The pumps were very efficient compared to competitors. They included working technical solutions which otherwise failed, on the market, at earlier points.

The turning point came with the development of a new product-service oriented pump concept based on a life cycle perspective. Analysis of energy consumption over the life time of a circulator pump indicated that energy consumption (end eventually environmental impact) during use counted for much more than 90% of the total energy consumption in the lifetime. This meant a fundamental shift in opportunity awareness and paved the way for the development of new market devices being able to translate the expenditure - cost saving structure of the product network. The pump market was transformed to accept higher initial expenditures against decreased running costs for power consumptions. In short this translation included the development and negotiation of a new energy labelling and classification scheme accepted as standard by EU and Europump - the European association of pump manufacturers. For Grundfos, the seeming unsuccessful development of a new pump technology without a market turned into a strategic advantage where the company could time the development and launch of a new pump to exactly meet the new standards two years before the competitors.

Internally in the company, the 'front end' space during the 20 years of development of the Alpha Pro concept included organisational controversies between strong visions of long term investments in technology driven innovation versus short term translations of business oriented goals. It also included shifts in the defining powers of competing engineering and marketing domains and consecutive occasions of reframing ideas of what constitutes an effective circulation pump. But, the decisive turn constituting a new stable actor network for the energy saving pump was enabled by the development of a new pump concept including a new life cycle perspective on costs and energy saving and a negotiated energy labelling scheme. The pump concept became the device enabling a reframing of what constitutes an energy effective circulation pump.

STAGING WITH DEVICES

In line with a number of authors as well as company experiences, this paper stresses the Front End of Innovation as a highly relevant space for shaping processes of design and innovation. While the contours of the processes in

this early phase are 'fuzzy', it is a realm of innovative activity in which the combining of knowledge from diversity of perspectives and for bridging engineering and market domains are nevertheless crucial. Other authors have pointed at the need for synthesising diverse knowledge and perspectives in the conceptualization of new products. Koen et al. [2], for example, elaborate on a number of tools and techniques that may be employed in the iterative product concept processes: those of opportunity identification, opportunity analysis, idea generation and enrichment, idea selection, and concept definition. Similarly, Hansen and Andreasen [20] suggest a mindset for innovative ideation, where a product idea is to be qualified through considerations as to the synthesis of partial dimensions, such as technology, product, product specification, tasks, needs, market, business, and strategy. While this is the case, we point to the need for addressing FEI as object for management, by drawing attention to the role devices play in the management of innovation, for shaping processes and outcomes.

None of the above approaches address their specific suggestions in terms of wider concerns as to organisational or sociotechnical processes, or link them to existing constraining or delimiting practices. As we have illustrated and argued for in this paper, the challenge for front end innovation is not synthesis of diverse perspectives as such. Rather, the crux of the matter for synthesis is to bring relevant perspectives together, in a process of sensemaking. This task is far from clear-cut and may indeed be counter-intuitive at the outset. It involves reframing of issues and exploring options, and discerning relevance, as part and parcel of conceptualising through the task of synthesis. The synthesis of contributions from potentially disparate knowledge domains in innovative processes, while maintaining focus upon the construction of the future market performance of imagined sociotechnical products is thus to work in a field of possibilities and tension. As Bucciarelli [21] points out, and is also illustrated in the notion of boundary objects, to design or innovate *across* boundaries and thus engage different object worlds, demands the translation of meaning and networks, realigning and transforming perspectives and interests. It is far from a straightforward undertaking, and highly strategic. For product ideas to gain currency in the wider organisation [8], and to thereby gain momentum, it should be recognized in innovation management, that involved actors enter the process

from a diversity of perspectives on what constitutes a 'qualified idea' [12].

In this paper we have taken the notion of devices from Actor Network Theory and theory of boundary objects and applied it as a sensitising device on the current practices in Front End Innovation. We have pointed at the importance of devices in their capacity as being able to constitute network building strategies, aiming at the development of viable product ideas and concepts and stable product networks. Devices are not just passive but may be important instruments of agency in the hand of concept engineers and managers. A concept of devices as presented here may in this understanding prove helpful in the refocusing on the content of innovative processes. In this way devices may contribute to opening up technology and market issues for management processes. Our research bridges, in this respect, established engineering design and innovation management approaches, by refusing a sole reliance on tool-oriented approaches to engineering or approaches focusing on the mere labelling of innovation processes, without regard to further elaboration as to their context and content.

The kind of devices as illustrated through this paper may play an important role in the staging, framing and management of innovative spaces characterised by a diversity of perspectives that need to be synthesised at relevant stages of the innovative process, starting with the front end. Consequently, some important tasks in staging these processes, and the need for further addressing this inquiry in future research and practice may be:

- to identify relevant actor worlds or object worlds and knowledge domains. How symbolic meanings are accorded, and approaches, perspectives, ideas and innovative contributions may be enacted are at the fore.

- to identify, explore and occasion to mobilise and configure devices capable of acting as translators, where relevant agency is drawn into the innovative space and enact relevant object worlds

- to identify, explore and maintain awareness as to the selective and constitutive nature of devices. Here paying attention to their inclusion vis-a-vis exclusion of diverse concerns and perspectives on outcome is at the fore.

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