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Lean product development and radical innovations – why lean is not enough

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1 Introduction

This paper deals with the effects of lean product development (LPD) on the innovative capacity of firms. It is shown that the – undoubtedly positive – intention to make development processes more effective and efficient through the implementation of LPD implies the latent risk to impair the company's ability to create high-grade innovations. Afterwards, ways to avoid this problem are presented.

2 Innovation and organizational ambidexterity

Innovation – that is, the invention and development of new products, services, processes or business models as well as their successful market launch and market penetration – has, for at least a decade, been one of the most used buzzwords in corporate practice, scientific research and politics. The question is no longer whether a company should pursue innovation or not, but it's about to innovate effectively and efficiently, i.e. "doing the right things right."

A very prevalent classification of innovations in relation to their degree of novelty is the dichotomy between incremental and radical innovations. Incremental innovations can be outlined roughly as

- more short-term oriented,
- closely related to existing products or services,
- aiming at identical or similar markets/market segments and present customers,
- based on existing technologies and
- linked with comparatively low risks and opportunities. [9]

Radical innovations however are

- more long-term oriented,
- based on new technologies and/or
- targeting new customers/markets/market segments,
- venturous, but – if successful – also linked with great rewards. [9][1]

The innovation strategies associated with this dichotomy are often called exploration (exploring new options and focusing on radical innovation) and exploitation (utilization of existing know-how and resources for the efficient creation of incremental innovations). However, hardly any company pursues one of these strategies in "pure form", because the differences between exploration and exploitation are not categorical, but gradually [18] – as well as in the differentiation of incremental and radical innovations. There is a broad consensus in innovation research that firms need to set the balance between the two prototypical innovation strategies depending on many external and internal factors, such as the dynamics of technology, the intensity of competition, their own resources and capabilities, or their current product portfolio. Most innovation researchers also agree that exploration and exploitation are fostered by (respectively require) different corporate cultures, people, processes, organizational structures, behavior and leadership/managerial styles (see Table 1).

[1] Christensen uses the two concepts of *sustaining innovation* and *disruptive innovation* [6]. A disruptive innovation is characterized (as opposed to sustaining innovation) through the creation of a new, or the takeover/replacement of an existing market. A radical (technological) innovation is – according to Christensen – a sustaining innovation and not a disruptive one. Christensen's definition, which is just one of a vast variety of terms [9], is not followed here. According to the position represented here, the terms radical innovation and disruptive innovation are synonyms.

	Exploration	Exploitation
Strategy	entrepreneurial, long-term, technology- and innovation-oriented	efficiency-oriented, short-term, product- and process-oriented
Search	remote	local
Knowledge	implicit	explicit
Learning	double-loop, generative, feedback	single-loop, adaptive, feed-forward
Innovation	radical resp. discontinuous	incremental
Structures	organic, decentralized, informal, open, project-oriented	mechanistic, centralized, formal, closed, functional
Control	input-control, self-control, confidence	process control, output control, contract
Network	open, weak connections	closed, strong connections
Leadership	transformational, visionary, participa-tive	transactional, authoritarian, top-down
Culture	relationship-oriented	task-oriented

Table 1: Characteristics of Exploration and Exploitation [18]

It is unclear, however so far, if there is a "natural" conflict between exploration and exploitation, the so-called "innovator's dilemma" [1], [6], or whether (and how) both strategies can be pursued in parallel (or sequentially/temporally, see section 5). The capability of a company for exploration **and** exploitation is denoted as organizational ambidexterity [15]. If implemented successfully, it is expected that organizational ambidexterity is associated with good financial performance and high adaptiveness/responsiveness of the company (each short-term and long-term). Two prominent recent examples, namely Kodak (digital photography) and Nokia (smart phones), show that even world market leaders, by their inability to respond appropriately to their competitors' radical innovations (i.e. due to a lack of responsiveness as a result of missing organizational ambidexterity) can quickly fall into an existential crisis.

3 Process management favors exploitative innovation

Process management considers companies not as organizational structures, but primarily as a system of interdepartmental and interrelated processes. These are analyzed, planned, implemented and optimized in the context of process management and must be observed during their active use. The management of processes is the central element of Total Quality Management (TQM) and other quality-oriented initiatives, such as the standards of EN ISO 9000, Business Process Reengineering (BPR), Six Sigma, Malcolm Baldridge National Quality Award (USA), Deming Award (Japan), Ludwig-Erhard-Preis (Germany) or EFQM Excellence Award (Europe). [4]

The aforementioned process-oriented methods vary in focus and approach, but they all aim at measuring, stabilization, rationalization and optimization of business processes ("organizational routines"). The targets of process management activities are efficiency and cost reduction, decrease of variability, improved customer satisfaction and finally higher income. [4], [13]

Altogether the empirical research on the effects of process management activities provides inconsistent results. Short-term efficiency improvements are reported frequently, soon followed by below-average financial results [4]. Even winners of the Baldrige Award (e.g. Motorola, Cadillac or Federal Express) have suffered from dramatic financial setbacks after their process-focused activities. [8]

Many of the abovementioned approaches have their origin in the field of production. However, the migration of these efficiency-increasing and variance-reducing measures over the boundary of the company's production system into upstream and downstream processes (such as product development, sales or service) often has – as discussed in section 4 in more detail – unexpected and undesirable effects on innovation, adaptiveness and responsiveness of the company, by overvaluing the merits of safety and predictability. In other words, process management tends to prefer exploitative innovation at the expense of exploratory innovation. [4]

4 Lean product development

The product development process is one of the core processes for the creation of innovations in enterprises. It is thus not surprising that it has become a focal point for improvement activities. LPD is a relatively new approach that promises the creation of more innovation in less time, at lower cost and with improved quality. The concepts of LPD stem from the "lean production", especially Womack's, Jones' and Roos' often cited analysis of the Toyota Production System [20], from which the generalized idea of an enterprise-wide lean thinking emerged. [19] The five core principles for leaner business processes through the elimination of waste are [1], [7], [14]:

- focus on the *value* from a customer perspective
- *value stream* identification and orientation
- *flow* principle
- *pull* principle[2] and
- striving for *perfection*

However, it is for the following reasons not straightforward to transfer these principles from production to product development [7], [11], [15]:

- Product development deals mainly with knowledge, information and creativity and not with physical products.
- Product development processes are complex, highly interrelated, parallel, iterative and less predictable than production processes. Furthermore they have longer cycle times.
- Provisional results of product development are difficult to measure and to evaluate. This manifests itself, for example, in the well-known phenomenon that the finalization of an – supposedly – already 95 percent completed development project may again require the same effort as "the first 95 percent".

The unreflected transfer of lean thinking from those corporate departments predominantly characterized by standardized and routinized processes to product development involves the risk that flexibility, creativity, motivation and finally the innovative capacity of the company – especially the skills for exploration, i.e. the creation of radical innovations – are impaired [1]. LPD must therefore be considered as another process-oriented approach that bears similar opportunities and risks as the methods assessed in section 3.

5 Creating respectively preserving ambidexterity

How then can process-oriented approaches such as LPD (or others, e.g. Design for Six Sigma) be utilized successfully for the product development process whilst organizational ambidex-

[2] The method to implement the pull principle in the Toyota Production System is "Kanban". Kanban was recently adapted as a process model for software development, with the aim to reduce the "work in progress" to achieve shorter cycle times and to disclose bottlenecks. It is thus an example of a method originally intended for production control being transferred to product development – in this case, the development of software. [2]

terity is created respectively maintained simultaneously? For this purpose, options to achieve organizational ambidexterity are presented at first. Afterwards it is explained that the early stages of the innovation process (the "fuzzy front-end of innovation", FFOI) are crucial to organizational ambidexterity. For the FFOI, the use of appropriate, non-process-oriented methods of innovation management is essential, while the focus of LPD are the subsequent, more structured and formalized phases of the innovation process.

The academic literature discusses different concepts for implementing organizational ambidexterity. The decision on the appropriate "mix" must be made on individual basis.[3]

- **Structural ambidexterity** separates exploration and exploitation activities in distinct organizational units. These units feature a high internal consistency, but differ greatly from one another. The inter-unit coordination and integration lies with the top management. [18]
- **Contextual ambidexterity** abstains from an organizational separation of exploration and exploitation, and focuses instead on the simultaneous accomplishment of both tasks by the same individuals and groups within an organizational unit. The management's task is to create incentives for creativity and flexibility on the one hand and for quality and efficiency on the other. Job rotation and job enlargement are examples of instruments to achieve contextual ambidexterity. [12], [18]
- **Temporal ambidexterity** assumes that the lifecycle of a company consists of comparatively long stable phases with only incremental changes along a given technological trajectory and short dynamic phases with technological leaps (radical innovations, new technological trajectory). The executives must in this case actively manage the transitions between exploratory and exploitative periods. [11], [18]
- **Domain ambidexterity** refers – in contrast to the previously mentioned approaches – to multiple knowledge domains. Ambidexterity is to be achieved by simultaneous exploration in the one and exploitation in the other knowledge domain. An example of domain ambidexterity is business cooperation in research and development (R&D) (functional exploration) between partners already familiar with each other (relational exploitation). [18]

Figure 1 shows the well-known pictorial representation of the innovation process as innovation funnel. The process begins with the FFOI. Here a vast number of ideas are to be generated. These are then typically evaluated, selected, further developed or tested in an iterative process. For highly innovative ideas special projects are performed (platform or breakthrough projects, advanced development). The best ideas are then advanced to the subsequent development stage until they finally reach product maturity. The development phase is more structured and formalized than the FFOI, which is also reflected in a greater process orientation (e.g. in the form of the stage gate process). The (few) development projects that successfully pass all "decision gates" in the course of development are finally brought to market.

[3] Each of the mentioned forms of ambidexterity can be considered on the levels individual, group, organization, alliance (i.e. inter-organizational) or (business) sector. [18]

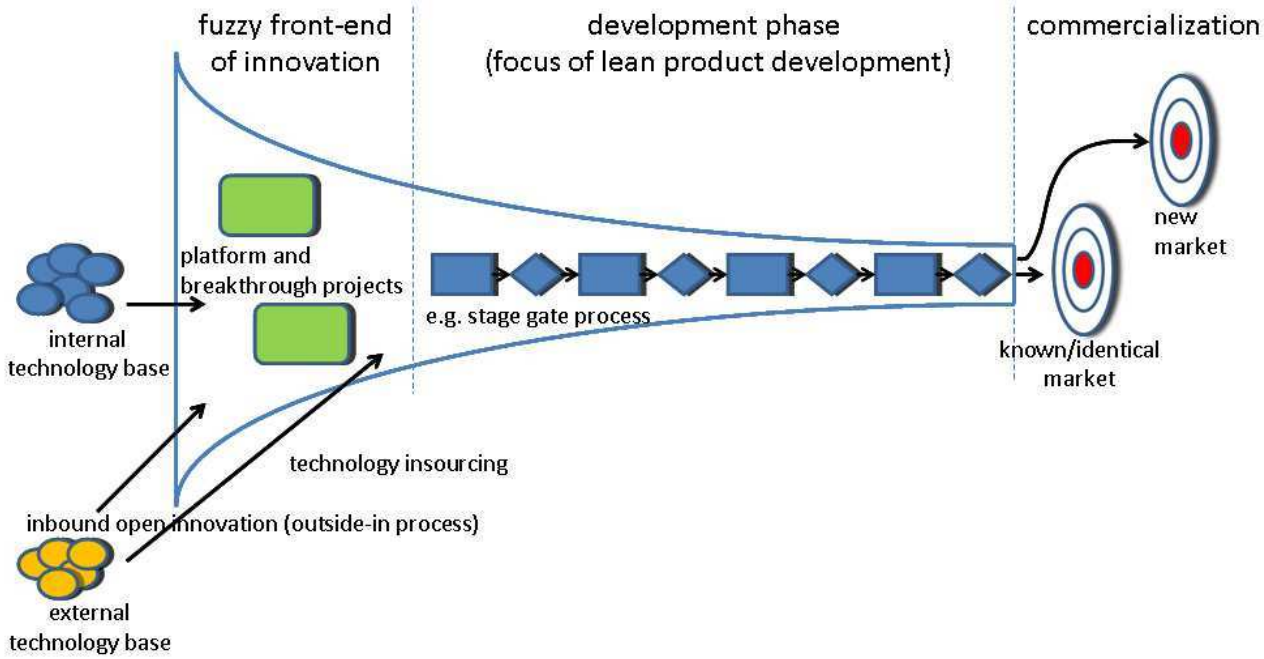

Figure 1: funnel model of the innovation process – the FFOI is vital to organizational ambidexterity; focus of LPD is the subsequent development phase

The FFOI is therefore of prime importance for the firm's

(1) exploration capabilities plus

(2) the innovation portfolio and thus the balance of exploration and exploitation.

Consequently the FFOI is vital for the company's organizational ambidexterity.

Innovation management provides a large variety of methods for the FFOI with respect to exploration, such as shown in the following – non-exhaustive – list [11], [17]:

- Put radical innovations on the **strategic agenda**
- **Observation of technology trends, technology and product road mapping**
- **Idea management and idea evaluation**
- **Management of the innovation portfolio**
- **Innovation competitions**
- **Integration of creative people, establishment of cross-functional project teams** as a secondary organization parallel to the primary organization
- **Promote breakthrough projects**
- **Internal venture capital** to pursue highly innovative projects in start-ups, spin-offs (a measure that leads to structural ambidexterity)
- Innovation through the use of **analogies**
- Cooperation with progressive customers (e.g. **lead user method**, **virtual communities**, **user-based product design tools**)
- **Cooperation** with external partners, such as research institutions or companies (see the example above regarding domain ambidexterity)
- **Open innovation**: Especially (as shown in Figure 1) "inbound open innovation" (outside-in process) or "technology insourcing" – i.e. the analysis and use (e.g. licensing in) of external technologies – is a method of exploration. In contrast, the "outbound

open innovation" (inside-out process) – i.e. the licensing out and commercialization of internal technology – is a means of exploitation (not shown in Figure 1). [5], [7]

6 Conclusion

Lean product development and – more generally – methods of process management "fit" well to the middle part of the "innovation funnel". They are one (or **the**) method of choice for the effective and efficient implementation of incremental innovation projects in periods of relative technological stability. However, they must not be misunderstood as a panacea, because they are less suitable for the use in the fuzzy front-end of innovation or in highly dynamic environments. The FFOI is crucial for the exploration capabilities and the balance between exploration and exploitation. Even when using LPD or other methods of process management it must be a top management's focus to maintain, respectively to improve the company's ability to create radical innovations. Apart from

- a corporate vision,
- an innovation strategy,
- a "fitting" corporate culture,
- the commitment of staff and management,
- effective teams and
- sufficient resources

this requires the utilization of suitable innovation management methods in the fuzzy front-end of innovation.

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