Abstract

The present research project aims for understanding the evolution of innovation strategy, studied in the context of medical devices activities of Novo Nordisk A/S; an incumbent pharmaceutical firm operating in the well established industry of insulin for diabetes treatment. The overall research question is: How does innovation strategy evolve? The research has the form of a longitudinal in-depth case study, covering the period 1980-2008.

As a basic theoretical frame, I have applied Burgelman’s evolutionary theory, especially his ‘internal ecology model’ of strategy making (Burgelman 1991, 2002).

My analysis identifies an induced strategy making process, which experiments with alternating innovation strategies through several lifecycles of strategy, thereby creating strategic variation over extended time. Thus, the case study models a more entrepreneurial role of the top management driven induced strategy process than traditionally described in evolutionary theory. In this case, strategic variation and trial-and-error learning is not restricted to the autonomous initiatives in the ‘internal ecology’; top management enacts induced strategic visions as experiments in the market. External feedback determines the destiny of these strategic experiments. Thereby, the induced strategy process, via cyclic experiments with innovation strategy, mediates internal and external ‘ecologies’ of the firm and in effect serves as a force of strategic entrepreneurship.

A specific finding in the present case study is that the induced process mediates innovation logics of core assets (pharmaceutical drugs) versus complementary assets (medical devices), by swinging the pendulum between cycles of innovation strategy.

Jelcodes: L29, M13
The induced strategy process as a force of strategic entrepreneurship

Abstract

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A specific finding in the present case study is that the induced process mediates innovation logics of core assets (pharmaceutical drugs) versus complementary assets (medical devices), by swinging the pendulum between cycles of innovation strategy.

Introduction and theoretical framework

This research project began with wondering about the reasons for apparent turbulence in innovation strategy at the Danish pharmaceutical company Novo Nordisk A/S. Such turbulence was not to be expected, since Novo Nordisk is a very mature company (founded 1923), acting in a relatively stable industry (product lifecycles of typically 20 years), based on a tradition of science and intensive R&D investments – not the kind of company, from which you expect impulsive fluctuations in the innovation strategy. The research centered on the overarching research question “How does innovation strategy evolve?”. Since I revisit Robert A. Burgelman’s (1991; 2002) framework on the ‘internal ecology’ of induced and autonomous strategies, I further address the topic with the question: What is the role of induced and autonomous strategy processes for the renewal of innovation strategy?
To study these questions empirically, I focused on the evolution of the innovation strategy for a specific area; namely, the medical device innovation activities from these began around 1980 to yearend 2008.

Searching for a theoretical framework, it should be noted that rational choice perspective on strategy, such as the positioning school (e.g. Porter, 1980), mainly are concerned with explaining the causes of superior business performance as reflected in the competitive landscape (the outcome of strategy), and less with analyzing the underlying process of strategy formation. The main question for rational choice theory on strategy can be stated as: ‘what kind of strategy should we build?’.

Conversely, the evolutionary theories are more focused on the actual behavior in the process of strategy making. The main question of such theories could be stated as: ‘where do strategies come from?’. Thus, Gavetti & Rivkin (2007) summarize the two research strands as “the content-oriented rational-choice class and the process-centered learning class” (p. 422). For the present research project, behavioural theories (or learning models) of strategy making provide the best foundation for understanding the evolution of innovation strategy.

The word strategy has two meanings or two dimensions: Strategy can be a forward-looking plan or vision or it can be a backward-looking "pattern in a stream of decisions" (Mintzberg, 2007). This dualism comprises a time-bound dimension: strategy as perceived before or after action.

Furthermore, strategies exist as concepts or theories in the minds of managers (in the form of forward-looking visions and plans; or backward-looking rationalization of experience) and they also manifest as patterns in actual organizational behavior. This dualism comprises a space-bound dimension spanning the two realms, in which strategy exists: the mental and the physical (Gavetti & Rivkin, 2007).

Consistent with these basic traits of strategies, all behavioral or learning oriented models of strategy-making conceptualize some sort of basic dualism between theory or reasoning on the one side and practice or action on the other (Nelson, 2008); or between strategy formulation and strategic action (Burgelman, 1988); or between cognitive, forward-looking strategic search and experience based, backward-looking strategic search (Gavetti & Levinthal, 2000). Although the concepts differ, the two basic dualisms (time-bound: before/after action and space-bound: mental/physical realms) can be synthesized into a simple model of a learning cycle, see figure 1, inspired by the experiential learning model developed by Kolb (1984). The model shows how strategy making unfolds in a learning cycle of theory application into practice, from which experiences fuel further theorizing. The theory builds on reasoning, derived from cognitive maps or mental models (Walsh, 1995; Nelson, 2008). Going from theory to practice is the theory-driven or forward-looking process (Gavetti & Levinthal, 2000), where cognitive models and beliefs are put to use (Walsh, 1995) in practice such as experiments or strategic action (Burgelman, 1988). This part of the learning cycle is normally associated with deliberate strategy making, because it springs out of a strategic intent or vision (even though this vision may be imperfect and often unconsciously biased by the cognitive models in use). Going from practical experience to theory is the data-driven, backward-looking process, where the experiences provide learning (Gavetti & Levinthal, 2000; Nelson, 2008), which again develops the cognitive
models (Walsh, 1995). This part of the learning cycle is normally seen as the basis of emergent strategy making, because the strategy is formed via trial-and-error, where the understanding develops en route (Mintzberg, 1994), or even backwards, as rationalization of experience (Burgelman, 1988).

The basic learning cycle in figure 1 synthesize the dualism between the mental and the physical realms in the vertical axis (between Theory and Practice) and the dualism between the forward-looking and backward-looking search processes in the horizontal axis.

Figure 1. Strategy making shown as a learning cycle between theory and practice (inspired by the experiential learning model developed by Kolb, 1984; figure 3.1, p. 42). Even the learning cycle is here depicted as one loop, the learning process of course is recursive and in principle endless; loop after loop unfolds.

The internal ecology of strategy making

The interplay between deliberate or theory-driven strategy making on the one side and emergent or experience-based strategy making on the other has been very thoroughly analyzed in Burgelman's evolutionary theory on the 'internal ecology of strategy making' (Burgelman 1991, 2002). He basically models how long-term adaptation of the corporate, induced strategy is achieved via continuous integration of local, autonomous initiatives from the 'internal ecology' of the organization.

Burgelman (1991) contrasts two sorts of strategy making processes: “The induced process concerns initiatives that are within the scope of the organization’s current strategy and build on existing organizational learning; the autonomous process concerns initiatives that emerge outside of it and provide the potential for new organizational learning” (p. 241). This definition, as can be seen, links to the content or scope of the strategy process and resembles the two modes of organizational learning described by March (1991): exploitation and exploration. However, Burgelman (1991) also links the
concepts to the organizational hierarchies: in the normal case, he claims that autonomous strategies work their way up from beneath the organization, whereas induced strategies are exactly ‘induced’ from the top. And further, Burgelman analyzes the process: Does the strategy develop out of local experiments, i.e. vision ‘ex post’, or does it develop out of cognition, i.e. vision ‘ex ante’? The normal distribution of these three parameters in Burgelman (1991, 2002) is shown in table 1.

<table>
<thead>
<tr>
<th>Content (per definition)</th>
<th>Autonomous strategy</th>
<th>Induced strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>Explores opportunities outside current strategy</td>
<td>Expands within current strategy</td>
</tr>
<tr>
<td>Actor</td>
<td>Lower or middle managers</td>
<td>Top management</td>
</tr>
<tr>
<td>Process</td>
<td>Action-based: learning from experiments (vision ex post)</td>
<td>Cognition-based / theory-driven (vision ex ante)</td>
</tr>
</tbody>
</table>

Table 1. The normal distribution of parameters in Burgelman (1991, 2002) for characterizing respectively autonomous and induced strategy.

In the theory of ‘internal ecology of strategy making’ (Burgelman 1991, 2002), variation in a company’s strategy is mainly created via autonomous initiatives, which usually emerge from bottom-up processes. Strategic renewal occurs when successful autonomous strategic initiatives are recognized via the so-called ‘strategic context determination process’ (Burgelman 1991, 2002) and integrated into the corporate strategy. See figure 2.

![Figure 2. A simplified image of Burgelman’s model of ‘internal ecology of strategy making’ (extracted from Burgelman, 2002). The concept ‘strategic context determination’ is the process by which corporate management recognizes a legitimate role of the autonomous initiative in the induced strategy.](image)

When applied to my empirical case study, some gaps of Burgelman’s framework remain:
- The ‘internal ecology model’ (Burgelman 1991, 2002) mainly connects the top-driven, induced strategy process with selection and retention; the role of the induced strategy process for creating strategic variation, or even strategic renewal, is underresearched.
Burgelman deliberately chooses an *intra-organizational* perspective, which to a large extent disregards the influence of external dynamics such as competitor moves (Burgelman 1991, p. 240).

**Strategic cognition**

The learning cycle in figure 1 includes cognitive representations of reality as part of the ‘theory’. Cognitive representations are analyzed in the vast literature on management cognition (see Walsh, 1995, and Kaplan, 2011, for reviews). The role of cognitive models for strategy formation is researched in the specific literature on strategic cognition (see Narayanan et al, 2011, for a review). This specific research analyzes how cognitive representations influence strategy making via framing processes (Kaplan, 2008), which define the scope of and expectations for the future activities (Noda & Bower, 1996) as well as future experiential learning (Gavetti & Levinthal, 2000). Furthermore, evidence shows that cognitive frames may be difficult to change and hence may result in strategic inertia (e.g. Tripsas & Gavetti, 2000). Such mechanisms have been summarized in the concept of *dominant logic* (Prahalad & Bettis, 1986; Bettis & Prahalad, 1995), which terms a top management worldview or mindset, created via reinforcement of experiences from the past. Such dominant logic, once established, is difficult to change but has strong effect on the strategic framing processes of a firm. Similarly, the *internal identity* of an organization has a guiding role for strategic decisions in parallel to cognitive frames and dominant logic (Tripsas, 2009).

When applying the research on strategic cognition to my empirical case study, especially one gap is significant:

- Most of the case studies are on technological discontinuities and environmental changes not controlled by the focal firm, setting top management in a reactive role (Barr, Stimpert & Huff, 1992; Christensen & Bower, 1996; Tripsas & Gavetti, 2000). The *entrepreneurial* role of top management cognition is underresearched.

**Integration of complementary assets for innovation**

Since my research question is on the evolution of innovation strategy, some concepts from the field ‘management of innovation’ are needed. For the empirical case study, especially the concepts *core and complementary assets* are relevant. The distinctions builds on Teece (1986), who describes innovation as comprising core technical knowledge, needed for the invention itself, and complementary assets, needed for the successful commercialization of the invention. Teece mentions processes such as marketing, manufacturing and after-sales support as examples of complementary assets. For this research project, however, it is essential that he also mentions: “when the innovation is systemic, the complementary assets may be other parts of the system. For instance; computer hardware typically requires specialized software” (ibid, p. 288). In this understanding, the medical devices in my case study may be seen as complementary assets, being part of the pharmaceutical product offering as a whole – but also potentially being seen as core technical knowledge, needed for
innovation on par with the other components, such as knowledge about the insulin drug. Christensen (2006) analyzes how growing technological complexity forces large companies into a role as ‘innovation architects’, who integrate both core and complementary assets for innovation in the total product offering. The unanswered question, which is relevant for my research project, is: What happens with the balance between core and complementary assets over time?

**Research design**

This research project aims at understanding the evolution of innovation strategy. Such purpose calls for a **process research model** rather than a **variance research model** (Van de Ven, 2007): “In general terms, a variance model explains change in terms of relationships among independent variables and dependent variables, while a process model explains how a sequence of events leads to some outcome” (p. 148; my emphasis). The fundamental difference between the two approaches is shown in figure 3. The process study approach does not exclude the search of causality; but the way to causality goes through “a narrative describing how things develop and change” (p. 148).

<table>
<thead>
<tr>
<th>Variance theory</th>
<th>Process theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explaining strategic change with a variance model</td>
<td>Explaining strategic change with a process model</td>
</tr>
<tr>
<td>Attributes of • environment • leadership • decision processes • performance</td>
<td>Strategy 1</td>
</tr>
<tr>
<td>Extent of strategic change $Y = f(x_1, \ldots, x_n)$</td>
<td>Strategy 2</td>
</tr>
<tr>
<td>• events • activities • choices</td>
<td></td>
</tr>
</tbody>
</table>

Figure 3. “Two approaches to explaining strategic change” - from Van de Ven, 2007 (p. 149).

My wish for detailed understanding of strategic change led to an inductive approach to qualitative research, going deep into the events in one organization. The empirical research consequently has the format of a longitudinal case study of the medical device area at a pharmaceutical company, analyzing the medical device innovation activities since the beginning of these activities around 1980 to year-end 2008. Such case study design opens for a ‘thick description’ of the events, contexts and interpretations (Stake, 2000, p. 437). The ‘thickness’ is achieved both via in-depth interviews and studies of archival data resulting in:

- **Analysis at multiple levels**: external industry dynamics; corporate events and top management cognition; local device level events (cognition, strategy and structure); and concrete innovation activities (innovation projects and product launches).
• **Mapping long term evolution** – across more lifecycles of strategy; this opens for seeing generic patterns.

**Data collection**

The data consist of public annual reports; a design case study published in 1993 (Freeze, 1993); internal documents especially on strategy; internal project portfolio lists and project documentation; a comprehensive internal report of the entire history of the Novo Nordisk device activities, made by a former device production manager in 2006; and 43 semi-structured, recorded interviews with current and previous managers from the device area as well as at corporate level.

The prioritization of data has been, in order of significance: Interviews – internal documents – public documents. The interviews were semi-structured and lasted from 10 to 123 minutes each (mean 58 min.). They were conducted in Danish language from June 2007 through August 2011. All interviews but one were recorded and 26 were transcribed. Detailed notes were taken in all cases but two. See a list of the interviews in table 2.
<table>
<thead>
<tr>
<th>Date</th>
<th>Position</th>
<th>Duration</th>
<th>Recorded</th>
<th>Notes</th>
<th>Transcribed</th>
</tr>
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</table>

**Table 2. List of interviews.**

<table>
<thead>
<tr>
<th>TOTAL/average</th>
<th>All but one</th>
<th>All but two</th>
</tr>
</thead>
<tbody>
<tr>
<td>43</td>
<td>0:58</td>
<td>26</td>
</tr>
</tbody>
</table>
Definitions

In order to identify the strategic phases and the linked transitions, two indicators were defined:

- **Strategic changes** are defined as changes in: 1) overall vision for or purpose of the device area; 2) targeted customer segments and value proposition; 3) field of activities; 4) source of revenue. Changes in these parameters were identified via statements in interviews and archival data.

- **Structural changes** are defined as organizational restructurings, in which the entire device innovation area at Novo Nordisk was moved around within the Novo Nordisk organisation; internal restructurings within the device area were disregarded. Structural changes were identified via the organizational charts.

Data analysis

For the analysis of the historical data, I followed the “steps in research on strategy formation” as described by Mintzberg (2007, p. 380-390). The described steps are:

1. **Basic data**: collect data to develop chronologies of decisions and actions, trends and events, and results – across all key strategy areas as well as aspects of the environment.
2. **Determination of strategy patterns**: map each track of events on a common timescale, if possible as visualized graphs under each other. Determine vertically the concurrent changes and identify and label the strategic periods.
3. **Analysis of each major period**: investigate intensively each period of the strategy, including drivers that shaped it, the underlying causes of changes in strategy and interrelationships. Conduct systematic theoretical analysis of each period of change in strategy by use of the chosen theoretical framework.
4. **Theory building**: Extract the core of each period and its drivers. Interpret, brainstorm, make hypotheses and extract conceptual insights, for each period and for the overall pattern in the whole study.

In step 2, I mapped in total 13 tracks distributed at 3 main levels – see table 3 below.
1. External environment:
   - Management dogmas (i.e. the prevailing concepts of management practice)
   - Pharma industry trends
   - Medical device inventions for diabetes
   - Impact of Type 2 diabetes
   - Insulin inventions
   - Pressure from competitors

2. Novo Nordisk corporate level:
   - Corporate management cognition and identity
   - Corporate strategy and events
   - Product tracks (drugs)

3. Novo Nordisk medical device level:
   - Product tracks (devices)
   - Device strategy
   - Device R&D organizational structure
   - Portfolio of ongoing device innovation projects

Table 3. The tracks mapped for the “Determination of strategy patterns” – step 2 in Mintzberg’s (2007) methodology (p. 381-383).

**Background: diabetes and Novo Nordisk**

Diabetes is defined as having too high blood sugar levels, and is caused by disturbances of the metabolism due to malfunction of the pancreas, which produces the hormone insulin. Insulin is a protein, which acts like a key, opening the cell pores for glucose molecules, thereby triggering the glucose metabolism. Type 1 diabetes patients have no insulin secretion from the pancreas at all, whereas Type 2 diabetes patients have reduced insulin secretion, often combined with reduced insulin sensitivity of the cells. Until Canadian researchers in 1921 discovered the function of insulin, Type 1 diabetes patients simply died. Type 2 diabetes does not imply a sudden malfunction of the pancreas; rather, the insulin secretion decreases over a couple of decades, combined with a decreasing ability of the cells to response to the insulin. The symptoms gradually get worse and many Type 2 patients end by having to treat themselves with insulin injections, just like Type 1 patients. Type 2 diabetes is partly lifestyle dependent and over the last decades, the global prevalence of type 2 diabetes has exploded. E.g. Danaei et al (2011) estimate that Type 2 has grown from app. 153 million people in 1980 to app. 347 million in 2008. This enormous growth has completely changed the market for insulin, because insulin at the same time has become more accepted and widespread as treatment for Type 2 diabetes.
Both Type 1 and 2 diabetes patients must try to compensate for the bodily dysfunction by taking in carbohydrates, if the blood sugar gets too low, or taking in medicine, if the blood sugar gets too high. Insulin injection has an immediate lowering effect on the blood sugar level, but besides insulin a range of less intrusive treatments exist, such as tablets (so-called OAD’s, Oral Anti Diabetics). The tablets either support the insulin secretion of the pancreas or the insulin sensitivity of the cells. In less serious cases of diabetes (i.e. Type 2 in an early stage), diet and exercise can be enough to lower the blood sugar levels.

To control the blood sugar and perform self-treatment, the patient has to monitor the blood sugar level by use of technical devices (blood glucose meters, BGM) and, in the case of insulin treatment, also has to inject insulin manually by the use of syringes or insulin ‘pen’ systems, or eventually by using a so-called insulin pump, which infuses insulin to the body continuously.

**Novo Nordisk A/S** came to existence in 1989 as a merger of two former rivals, Novo Industry and Nordisk Gentofte, both Danish insulin manufacturers established in respectively 1925 and 1923. Novo Nordisk today defines itself as a leader in the diabetes care market, mainly active within the insulin business, producing the insulin drugs as well as the injection systems for the drug delivery. By yearend 2010, Novo Nordisk had a global market share of the insulin market of 51% (measured in volume) and was by far the world’s largest insulin manufacturer. The company employed 30.000 people worldwide by yearend 2010. Medicine for diabetes accounted for 75% of Novo Nordisk’ turnover; the other business areas being growth disorder, haemophilia and menopause treatment. Headquarters are in Denmark.

**The corporate DNA**

Nordisk Gentofte was founded by the Nobel Prize winner in physiology, August Krogh. His wife, Marie Krogh, practiced as a doctor and researched in human metabolism. Furthermore, she had diabetes (Type 2) herself, and she consequently had a natural interest in diabetes. In 1922, August and Marie Krogh therefore went to Canada to visit the scientists, who had discovered insulin the year before. Being a Nobel Prize winner in physiology 1921, August Krogh easily persuaded the Canadian scientists to give him a license to manufacture insulin in Denmark (using a process, which derived animal insulin from the pancreas of cows and pigs). So, if we are looking for the roots of the internal corporate identity (Tripsas, 2009), I think it is fair to identify these as the combined scientific and medical standpoint of the founders (Novo being a break-out from Nordisk). This identity had impact of the framing of the business (Kaplan, 2008) and thus laid the ground for the learning cycles which established and reinforced the dominant logic (Prahalad & Bettis, 1986) of Nordisk as a science-based, pharmaceutical company.
Findings

Summary of the evolution

The medical device activities began separately in the two companies Novo and Nordisk around 1980. After some years of positive experiences with medical devices, the two companies merged in 1989 and organized the device activities in a separate division, in parallel to the drug divisions. The ‘honeymoon’ after the merger was a very optimistic and entrepreneurial period, and devices (especially disease monitoring devices) were envisioned to become a substantial business of its own. However, the corporate business portfolio after the merger was far too broad – a focusing process started, also inspired by the new management dogma of ‘core competencies’ (Prahalad & Hamel, 1990). In 1992, a crisis hit the company badly, and this amplified the ongoing process of divesting ‘non-core’ business areas. The device activities were confined to only comprising insulin pens – insulin pumps and monitoring devices were terminated. In 1995, the device area was moved to a Production subunit. Within the limited scope of insulin pens, there was here a blooming activity of incremental product innovation until the next strategy shift in 2001; now devices were again envisioned to create substantial new business, including glucose monitoring and ‘everything the patient needed to control his/her disease’. As a new organizational frame, the device innovation activities were separated from device production and got status as an independent R&D unit within corporate R&D, having the same status as the drug R&D units. This new phase experienced a setback already in 2002, due to a financial crisis which made the corporate top management team far more cautious and conservative. Thus, the glucose monitoring projects were closed down in 2004. The strategy, however, was not officially altered until 2005, where the device innovation activities were integrated into a drug research unit. The strategy now was ‘back to basics’, i.e. insulin pens. In this period, the device innovation was modest, both quantitatively and qualitatively. By yearend 2008, the device innovation activities were reorganized again. – Table 4 provides an overview of the evolution.
<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Overall vision or purpose</td>
<td>Supporting new diabetes treatment forms (so-called basal-bolus treatment and pump therapy)</td>
<td>The vision of patient-centered homecare, supported by a medical system</td>
<td>Getting back on safe track</td>
<td>Device activities should support the drug business via market segmentation</td>
<td>The visions of closed loop and system integration; 'one-stop-shop to diabetes'</td>
<td>The 'value added pharmaceutical product', to secure NN leadership via market differentiation</td>
</tr>
<tr>
<td>Autonomous / induced strategy</td>
<td>Mixed picture – mostly autonomous</td>
<td>Autonomous</td>
<td>Induced</td>
<td>Induced</td>
<td>Autonomous</td>
<td>Induced</td>
</tr>
<tr>
<td>Top driven change or bottom-up</td>
<td>Top driven</td>
<td>Top driven</td>
<td>Top driven</td>
<td>Top driven</td>
<td>Top driven</td>
<td>Top driven</td>
</tr>
<tr>
<td>Role of devices: Core / complementary</td>
<td>Novo: Complementary.</td>
<td>Core</td>
<td>Complementary</td>
<td>Complementary</td>
<td>Core</td>
<td>Complementary</td>
</tr>
<tr>
<td>Corporate organizational structure</td>
<td>Multidivisional (M-form)</td>
<td>Multidivisional (M-form)</td>
<td>Multidivisional (M-form)</td>
<td>Functional (U-form)</td>
<td>Functional (U-form)</td>
<td>Functional (U-form)</td>
</tr>
<tr>
<td>Organizational setup of device activities</td>
<td>More or less hidden in small departments</td>
<td>Own division</td>
<td>Subunit under the Diabetes Care Division</td>
<td>Subunit under Production (in new corporate, functional organization)</td>
<td>Device R&amp;D separated from device production, as one of 3 functional areas at corporate R&amp;D</td>
<td>Device R&amp;D integrated into the diabetes drug research unit as 3 VP areas</td>
</tr>
<tr>
<td>Value proposition for customers / users</td>
<td>Enabling more convenient treatment forms for patients (flexibility)</td>
<td>Enabling homecare of the patient</td>
<td>Convenient injection devices for the patient</td>
<td>Convenient devices for the patient, 'meeting individual needs and lifestyles' (via segmentation)</td>
<td>Better glucose control and convenience for the patient, via (intelligent) closed loop systems</td>
<td>Increased Quality of Life via convenient devices for the patient, combined with drug benefits</td>
</tr>
<tr>
<td>Glucose monitoring included in the development portfolio</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Envisioned revenue from devices</td>
<td>Novo: No</td>
<td>Nordisk Gentofte: Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 4. Overview of the historical epochs of the device activities at Novo Nordisk.

The phases are here defined by structural changes. If the structural change took place in the middle of a year, this year is attached to both periods – for example, DRU was established in the summer of 2005, hence the year 2005 is attached to both the PDS and the DRU period.
The strategic epochs

If we disregard the structural changes and focus on the transformations of innovation strategy, the case unfolds five overall periods, namely:

1) **The early attempts 1980-88:** where Nordisk started with insulin pumps and Novo with insulin pens. These were entrepreneurial activities, which still lacked a formal strategy. Thus, in Burgelman’s (1988) terminology, the period represents the *emergent* state; before institutionalization of strategy. The medical devices were welcomed as one business opportunity amongst others. Several factors paved the way: a) the prevailing management dogma of diversification (e.g. Ansoff, 1965), where devices fit well in as yet a business opportunity; b) developments in diabetes treatment had made multiple daily insulin injections necessary for the patient, and continuous infusion from insulin pumps was discussed as the future; c) Eli Lilly developed and launched recombinant human insulin in 1982, and this disruptive technology threatened to make animal insulin obsolete – both Novo and Nordisk were years behind, and hence were looking for other parameters of competition. The devices thus served a purpose as market differentiators. Both companies were successful with their early device activities (Nordisk with insulin pumps; Novo with insulin pens) – and hence, the ‘theory’ about devices as means of market differentiation in the competitive landscape was reinforced.

2) **Medical Systems Division (MSD) 1988-92:** The strategic vision of **patient-centered homecare**, based on a medical system, became anchored in a new ‘Medical Systems Division’. MSD was established in 1988 as a business unit at Nordisk, which was envisioned to establish devices as ‘the third business leg’, besides two existing pharmaceutical divisions, Diabetes and Biopharmaceuticals (the latter taking care of other diseases than diabetes). Devices should create revenue streams of their own – partly by selling devices such as insulin pumps, partly by manufacturing devices for other pharmaceutical companies. The activities comprised drug delivery (pens and pumps) as well as disease monitoring devices (e.g. glucose monitoring). The overall vision was patient-centered homecare, supported by a medical system, comprising the drug, the delivery system and the monitoring system. See figure 4.
As a genuine division, MSD comprised the usual business functions: Marketing, R&D, Production, Quality, Regulatory, Logistics etc. The revenue stream for the business unit was envisioned to come from the sales of insulin pumps as well as utensils/accessories for the pumps (infuser sets etc.), to be supplemented later with revenue from selling monitoring devices and utensils for these. The activities grew rapidly, and by the merger with Novo in 1989, MSD employed 119 persons. “It was a dynamic period, something happened all the time – it was full steam ahead all the way through”, as one informant puts it. At the merger, Nordisk was recognized by Novo as having the strongest organization for medical devices. Consequently, MSD was continued as the organizational frame of the joined device activities with the status as one of five divisions in the Health Care Group of the merged company.

The merger of Novo and Nordisk in 1989 resulted in managerial optimism – as explained by an executive informant: “By the merger, we suddenly get in new product areas, the palette is much larger, and everybody is excited – now we can join in with the large companies and so on…”

Still, MSD was only successful with insulin pumps and pens – the glucose monitoring projects were never launched. Hence, the ‘theories’ about ‘the third business leg’ and patient-centered homecare gave mixed results. However, external events had greater impact on the destiny of the MSD strategy.

3) **The focusing and harvesting period, 1992-2001**, in which insulin pumps were sold off and disease monitoring projects were stalled – focus was directed explicitly at insulin pens, and devices were to support the drug business. This phase was partly evoked by a quality crisis in 1992-94, and partly by Novo Nordisk being behind competitors with regards to the insulin pipeline. Thereafter, as result of the corporate restructuring from multidivisional into a functional organization, the device activities in 1995 were transferred to Production, under the name Medical Systems (MS). The strategy was not changed in 1995 – focus was still on insulin pens only.
In 1992, top management seems to have been inspired by the new management dogma about focus on core competencies (Prahalad & Hamel, 1990), facilitated by dialogue with external consultants. An executive informant explains: "After the merger, the company suddenly gets bigger, we get more competencies and business areas, and more resources – and the subsequent business strategy is very broad, also broader than the resources and competencies could cover. I guess that's why the progress was not as immediate as hoped for... a very broad portfolio, much bigger than our resources and management competencies could cope with". Consequently, the focusing of the business began already in 1991, when Novo Nordisk divested their veterinary business, and continued thereafter. Medical devices were in this process disregarded as 'core business'; but kept in-house.

Externally, however, other problems occurred. In 1993, the U.S. Food and Drug Administration (FDA) criticized the insulin manufacturing at Novo Nordisk; according to FDA, the manufacturing did not live up to the U.S. standards of Good Manufacturing Practice (GMP). The crisis meant an internal shock in the organization, since it hit the core of Novo Nordisk's business and historical identity. As an executive informant says: "It shook the very foundations of the company". The crisis is internally referred to as 'the GMP crisis' and is still a sensitive issue.

Thus, several factors all together led to the retreat from the former explorative MSD strategy. External events were important drivers, accompanied by top management interpretation:

- Apparently, top management realized that the business portfolio of the merged Novo Nordisk in 1989 was far too broad, held up against the management resources and organizational capabilities.
- Top management also perceived the drug pipeline of Novo Nordisk as being behind competitors.
- Further, the shift in general management paradigm from 'diversification' (e.g. Ansoff, 1965) to focus on core competencies (Prahalad & Hamel, 1990) probably has strengthened the wish to focus the business, brought to top management's attention by external consultants.
- The GMP crisis amplified the corporate focusing process, and drove the change in device innovation strategy towards focusing on insulin pens only.

Consequently, the changed strategy for the device area from 1992 became to focus solely on supporting the pharmaceutical drugs with superior injection devices, i.e. insulin pens. In spite of this narrow scope, there is in fact an impressive list of new product launches (most of them representing incremental innovations) from the period of Medical Systems (1992-2001), with a broad spectrum of insulin pens and accessories.

The focusing at corporate level, however, continued. For corporate management it was vital to keep Novo Nordisk as an independent company. In order to secure independence it was perceived necessary to focus on selected areas and build deep competencies within these; "we will compete with the big boys in areas where they cannot compete with us" as expressed by an executive at that time. Michael Porter (1980) would call this a 'focus strategy'. The efforts to focus the business led to a
corporate reorganization into a functional, U-form structure (Chandler, 1992) in 1995, which was better suited for deepening the competencies within a narrow area.

In the period after the corporate restructuring in 1995, the device area was placed as a functional area under Production. This implied relatively little attention from corporate management, and also relatively high degree of freedom, as long as the overall strategy was not challenged – i.e. focus should be on insulin pens. Some informants have mentioned this relative freedom as a positive side effect – and in fact, the product innovation seems to have bloomed, even though it was within a confined area. Such an environment could be seen as ideal for autonomous initiatives in the classical Burgelman (1991) sense; but the actual innovation projects extended the established strategy – for example, supplementary products were developed such as needle inserters, and the devices were customized for different customer segments. There were no attempts to create new business or independent revenue streams based on devices, or to explore new product-markets. Still, within the confined area, the activities were highly successful; thus the practice reinforced the ‘theory’ of devices as means of market differentiation.

4) Protein Delivery Systems (PDS), 2001-05: In 2000, a new strategic vision for ‘closed loop’ and ‘one-stop-shop to diabetes’ (to be explained in a moment) was conceptualized. The implementation was postponed until 2001, where Protein Delivery Systems (PDS) was established as the organizational frame for the new holistic device innovation strategy. Thereby device R&D was separated from device production, which remained under the corporate Production unit. The innovation strategy included both insulin delivery and continuous glucose monitoring and envisioned substantial revenue streams based on devices.

The change of strategy began at a special workshop in 2000 for the team of corporate managers from Operations (production, sales and marketing), where the device activities were placed as a subunit to Production. The background was discussions in the pharmaceutical industry about diversifying from medical drugs into total healthcare solutions, as well as general attention to potential revolutions in diabetes treatment. The workshop was ignited by input from an external management professor on topics around possible future changes in diabetes treatment: What could change the whole business model? What were the unique strengths of Novo Nordisk? Why didn’t Novo Nordisk set more outrageous ambitions for diabetes control and convenience for the patients? Why didn’t Novo Nordisk play the role as system integrators and then deliver the most convenient products to the patient? – During the next half year, a taskforce driven by managers outside the device area made a detailed plan for a new device organization. After some consideration, the Executive Management Committee approved the plan and released the funding.

The new device strategy was based on the so-called ‘closed loop’ vision: A system mimicking the functions of the healthy body by combining an insulin delivery system with a blood glucose monitoring system. This meant that the monitoring of the blood glucose level and the infusion of the needed amounts of insulin could be maintained automatically in a ‘closed loop’ of delivery and feedback, without the patient having to worry about it. "Closed loop was broadly discussed in the
diabetes society – it was like the 'holy grail' of diabetes treatment”, as a key informant put it. The ‘closed loop' might resemble the 1988 vision of ‘homecare’ (see figure 4). However, the big difference is the continuous monitoring of blood glucose and infusion of insulin, carried out by a more or less automatic system. Thus, to construct ‘closed loop’, the devices had to move from mechanical products to ‘intelligent products’, enabled by electronics and software solutions. Detailed business plans were created for the needed development projects, and the emphasis was on business creation, since the strategy again (like in the MSD phase) opened for entering the market for glucose monitoring. "Yes, we wanted to develop total systems. Everything, the patient needed to control his/her blood glucose level. We wanted to be a ‘one-stop-shop’ to diabetes".

According to some informants, the PDS strategy left little attention to the need for lifecycle management of existing products; that is maintaining the existing products with continuous improvements (often production-wise) or developing new versions with incremental improvements. One informant says "There were skeptical people saying that we would risk losing our leading position in our core area. I guess this partly also happened. For a time we did not develop ‘engines’ for our injection pens. I guess it gave some sort of set-back. On the other hand, top management was not willing to increase the frequency of introducing new pen generations". An executive informant puts it: "We kind of diluted the classical virtues – our resources within the classical disciplines – in such way that we lost momentum. And at the same time we placed our resources in high risk areas; it was too much ‘blue sky’ – we were too optimistic, we believed the solutions were just around the corner."

So, to sum it up: PDS was not successful, neither in developing advanced closed loop systems, nor in building business based on devices. The experiences led to negative reinforcement of the ‘theory’.

5) Diabetes Research Unit (DRU), 2005-08: A financial crisis already in 2002 undermined the risk willingness needed for the ambitious visions of PDS, and in 2004 the continuous glucose monitoring project was terminated; but the strategy was not officially changed until 2005, where the innovation strategy returned to a ‘back to basics’ mode, i.e. focus should be on insulin pens, like in the MS period (1992-2001). The device innovation activities were in the period 2005-08 integrated into a drug research area, Diabetes Research Unit (DRU).

The strategy for DRU was to secure the leadership of Novo Nordisk within the diabetes care market by building on the strength and synergy of integrated drug and device development within one organizational unit. The core competence was termed the “value added pharmaceutical product” as a description of the integrated drug-device system. The activities were focused, and the most radical innovation projects from the PDS phase were stalled. “It was back to basics: let’s do what we are good at and know we can do”, as one informant commented.

Another external event was the failure of certain competitors’ tablet products in the market, displaying cancer risk, which led to increased demand for insulin in treatment of Type 2 diabetes. This growth opportunity might have reinforced the investment in the ‘closed loop’ strategy, but instead resulted in a return to a purely drug-based strategy. The technical problems with the
advanced device solutions, combined with the fear of getting behind within the classical insulin pens, pushed management in the direction of retreat rather than investment in the PDS strategy. Thus, the DRU strategy was a return to a drug-based innovation strategy. Top management perceived the market changes as a ‘renaissance’ for the classical core competencies; primarily insulin drugs. DRU was successful in the focusing efforts, but did, in its short lifetime, not generate substantial new product innovation. DRU was discontinued by yearend 2008.

All in all, there have been two waves of device-based innovation strategy, where devices were foreseen to create a business of its own – 1988-92 and 2001-05 – the rest of the period 1980-2008, devices have been perceived as complementary assets for innovation, which should sustain the drug-based business strategy.

**The pattern of evolution**

To identify an overall pattern, I have classified the device innovation strategies as falling in two distinct modes: A) autonomous, device-based strategy, including new business creation and a systemic or integrated approach to innovation – these strategies are defined as ‘autonomous’ since they aimed for entering new product-markets; i.e. they were autonomous in content; B) induced, drug-based strategy, focused on devices as complementary to the drugs. The result of this distinction can be seen in figure 5.

![Figure 5. A model of the development of device innovation strategy at Novo Nordisk. The ‘early attempts’ have a dotted outline, since these activities represent the ‘emergent state’ (Burgelman, 1988) – before institutionalization of strategy.](image-url)

The ‘mode A’ strategies were not (or only partly) successful and hence were not reinforced to become integrated in the corporate ‘dominant logic’ (Prahalad & Bettis, 1986). Conversely, the ‘mode B’ strategies were most of the time successful and therefore reinforced the drug-centered strategy.
**Discussion**

My analysis in figure 5 shows a cyclic pattern of alternating modes of strategy, which content-wise could be characterized as either autonomous or induced. Hence, the evolution unfolds strategic variation over time, via cycles of shifting innovation strategy.

The autonomous cycles of device-based innovation strategy had the challenge to escape the gravity of the internal identity and the corporate dominant logic (Bettis & Prahalad, 1995), which was pharmaceutical and drug-centered. Neither of the two device-based strategic waves achieved momentum enough to escape the gravity for real – in each case, competition and crises made the strategy bend back to the safe ‘fetal position’, centered on the drug. Hence, the dominant logic showed itself as a more enduring component of management cognition than the more instrumental strategy formulation – like a deep structure (Gersick, 1991) of strategy making.

Even though the two device-based strategy waves were surely autonomous in content, because they aimed for establishing new product-markets, they were created out of top management reasoning, ‘vision ex ante’. In this sense, the strategy making followed the induced strategy process as analyzed in Burgelman (1991). I therefore define the strategy cycles, inclusive the content-wise autonomous waves, as part of the corporate induced strategy process. As such, the two device-based strategy cycles can be seen as induced strategic experimentation; new strategies were formulated as hypotheses, which were tried out for real, but still subject for learning. My analysis suggests an induced strategy making process at incumbents, which experiments with alternating innovation strategies through several lifecycles of strategy, thereby creating strategic variation over extended time. This understanding identifies an underresearched, entrepreneurial role of the induced strategy making process and of top management cognition. In emergent views on strategy formation (e.g. Mintzberg, 1994, 2007; Burgelman, 1991, 2002) reasoning and strategy formulation marks the end of an explorative and action-driven learning process. In my case study, strategy formulation also marks the beginning of a theory-driven, yet explorative learning process: from the external ecology, the induced strategy process intercepts novel opportunities or threats; integrates these in the strategy formulation as strategic hypotheses in the form of innovation strategy; initiates the structural context determination (Burgelman, 1991) for the new innovation strategy; and enacts the new strategic hypotheses into the external environment, for example in the form of new products. Based on the response in the market, the new strategic experiments are either reinforced or withdrawn. This theory-driven and entrepreneurial learning cycle takes place within the top management driven, induced strategy process.

Burgelman (1991) recognizes the existence of variation created by induced processes, but this phenomenon is described as far more constrained than the creation of the strategies for MSD and PDS: “Of course, this does not imply that there is no planned variation in the induced process. Clearly, there is room for core technology advances, new product development for existing product families, new approaches to marketing and manufacturing and so on” (p. 246 – my emphasis). This
characterization does not correspond with the revolutionary characteristics of the two device-based strategic waves at Novo Nordisk.

Seen as above, the induced strategy process is far less 'institutionalized' than described by Burgelman (1988, 1991). The induced strategy process demonstrates plasticity in two dimensions:

1. Towards the **internal ecology** via strategic context determination, which intercepts valuable autonomous initiatives (as analyzed by Burgelman 1991, 2002). This is primarily a process of experience-based, backward-looking strategic learning, which reformulates the strategic vision ‘ex post’.

2. Towards the **external ecology** via cycles of interception of change, reasoning (interpretation) and strategy formulation, enactment of new innovation strategies, interception of the response from the market and so forth. This strategic learning process is primarily forward-looking, vision ‘ex ante’; but experience-based learning also occurs, via feedback loops from the market.

Therefore, the induced strategy process can be seen as a dynamic ‘exchange market’, which mediates between internal and external ecologies in an iterative strategy creation process, by means of *induced strategic experiments*, i.e. enactment of alternating innovation strategies over time. This conception of the induced strategy process does not eliminate the ‘internal ecology’ model described by Burgelman (1991, 2002). Rather, it adds another layer of strategic entrepreneurship to the internal ecology model. See a model of my analysis in figure 6.

![Figure 6. A model of the induced strategy process as an 'exchange market', mediating between internal and external 'ecologies'. The model shows an entrepreneurial role of the induced strategy process, displaying plasticity in two dimensions: Towards internal ecology by integrating successful autonomous initiatives, as described in Burgelman’s 'internal ecology' model of strategy making (1991); and towards external ecology by enactment of induced experiments with innovation strategy. If these experiments are successful, the](image-url)
strategic hypotheses are reinforced, and this may lead to renewal of the corporate induced strategy. If the strategic experiments fail or meet significant resistance in the environment, the existing strategy and its dominant logic instead are reinforced.

This theoretical interpretation of my empirical findings leads me exactly into the ‘middle ground’ between behavioral and rational-choice perspectives on strategy, which Gavetti & Levinthal (2004) propose as the future theoretical paradigm to be developed, based on evolutionary theory. In such ‘middle ground’, deliberation and reasoning should not be seen in contrast to learning.

The induced strategy process unfolds both modes of organizational learning described by March (1991): exploitation and exploration. And these are both practiced in two directions; towards the internal and the external environment. I suggest labeling these two directions of strategic learning respectively ‘inbound’ and ‘outbound’ (inspired by Porter’s labels ‘inbound and outbound logistics’ in the classical value chain analysis, e.g. Porter, 1991).

**Inbound**, strategy holds a function of alignment and control (cf. Porter, 1991). The whole purpose of strategy is to establish enduring elements of corporate behavior, thus selection and retention is needed within the ‘internal ecology’. Without this function of strategic selection and retention, the activities of a firm would pursue countless autonomous directions, in effect dissolving the strategy and the business itself. The dominant logic facilitates this function as an enduring element of management cognition: “Interestingly, it provides a set of heuristics that simplify and speed decision making. This inherently results in ‘adaptive ability’, so long as changes in the underlying logic are not necessary” (Bettis & Prahalad, 1995, p. 11). This function of alignment establishes the exploitation mode of inbound strategic learning. However, the induced strategy process also has a dimension of inbound exploration, by opening up for interception of autonomous initiatives: “The capacity to activate and successfully complete such processes [autonomous initiatives and strategic context determination] can be viewed as a measure of the intelligence of the company’s internal selection environment and may be at the very heart of strategy making as an adaptive organizational capability” (Burgelman 2002, p. 355).

**Outbound**, strategy has a similar function of alignment of the activities and exploitation of established positions and capabilities. However, the induced strategy process also holds an explorative function via anticipation of change in the environment. This function is established via experiments with alternative strategies in order to sustain the adaptability and viability of the firm. Hence, strategic variation is sought by testing alternating innovation strategies as ‘strategic hypotheses’ via extended learning cycles in the market. For this purpose, innovation strategy serves as a ‘strategy lab’ for the induced strategy process. Here, the gravity of the dominant logic poses a permanent challenge: it may momentarily loosen up for new innovation strategies, but it pulls back to safe territories when encountering crises.
Table 5. The strategic learning modes of the induced strategy process.

<table>
<thead>
<tr>
<th>Exploitation</th>
<th>Outbound</th>
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<tbody>
<tr>
<td>Expanding existing strategy and capabilities</td>
<td>Expanding existing strategy and established product-markets</td>
</tr>
<tr>
<td>Exploration</td>
<td>Strategic context determination of autonomous initiatives from the ‘internal ecology’ (Burgelman, 2002)</td>
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The above analysis (summarized in table 5) of the learning modes of the corporate induced strategy process builds on a longitudinal case study of the evolution of innovation strategy, for a complementary product area within a mature company. More research is needed for generalization of such theory.

**Conclusion**

The present case study encompasses a longitudinal analysis of the strategic evolution in a specific organization, including multiple levels of analysis.

As a result, the case study models a more entrepreneurial role of the top management driven induced strategy process than traditionally described in evolutionary theory. In my case study, strategic variation and trial-and-error learning is not restricted to the autonomous initiatives in the ‘internal ecology'; top management enacts induced strategic visions as experiments in the market. External feedback determines the destiny of these strategic experiments. Thereby, the induced strategy process mediates internal and external ‘ecologies’ of the firm and in effect serves as a force of strategic entrepreneurship.

A specific finding in the present case study is that the induced process mediates innovation logics of core assets (pharmaceutical drugs) versus complementary assets (medical devices), by swinging the pendulum between cycles of innovation strategy. Thus, the balance between what is defined as core and what is defined as complementary in the corporate innovation strategy seems to be dynamic and negotiable.

**Implications for research**

Burgelman (2002) sees an organization’s ability for strategic renewal as depending on its ability to exploit the internal ecology of autonomous initiatives. This understanding builds on case studies of respectively internal corporate venturing units (Burgelman, 1988) and a young IT company in a young industry (Burgelman, 1991, 2002). My research proposes that a firm’s ability for strategic renewal might depend both on strategic context determination of autonomous initiatives (as in Burgelman, 2002) and on ability to exploit induced strategic experiments via enactment of alternating innovation strategies. However, my analysis of this more entrepreneurial role of the induced strategy process might be bound to the specific circumstances of the evolution of local innovation strategy or...
to the integration of *complementary assets* for innovation within the setting of a mature (incumbent) company in a stable industry. The big unanswered question remains: is my analysis context specific, or does it have validity for other mature companies in stable industries? In any case, the existence of *induced strategic renewal* should be examined further in research at the ‘middle ground’ of business strategy (Gavetti & Levinthal, 2004). The understanding of innovation strategies as *hypotheses* – serving as a laboratory for corporate strategic renewal – might here add to the theories on strategic search.
References


