



# Change factors requiring agility and implications for IT

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## Abstract

The current highly dynamic business environment requires businesses to be agile. Business agility is the ability to swiftly and easily change businesses and business processes beyond the normal level of flexibility to effectively manage unpredictable external and internal changes. This study reports on a cross-industry analysis of change factors requiring agility and assesses agility gaps that companies are facing in four industry sectors in the Netherlands. A framework was constructed to measure the perceived gaps between the current level of business agility and the required level of business agility. The questionnaire and in-depth interviews held reveal that today's businesses perceive to lack the agility required to quickly respond to changes, whose speed and requirements are difficult to predict. The paper presents rankings of generic and sector-specific agility gaps. These show that although some generic change factors requiring agility exist, the change factors requiring agility that cause agility gaps differ across industry sectors. Among the factors that enable or hinder business agility, the existence of inflexible legacy systems is perceived to be a very important disabler in achieving more business agility. A number of basic principles and directions are discussed to transform Information Technology from barrier into key enabler for increased agility in organizations and business networks.

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## Introduction

### Background

It is often stated (cf. Kenneth Preiss *et al.* (1996)) that the highly dynamic business environment requires businesses to adjust and act swiftly, in other words to be 'agile.' As a result the concept of 'agility' receives growing attention. Numerous books and articles have appeared that attempt to define business agility. Academic literature and the professional press have discussed the topic by reporting on recent unexpected threats to businesses such as terrorism, unanticipated regulations or sudden market changes, and how agility can help to overcome these. Several Consultancies and Information Technology (IT) vendors have made it their key strategy to help organizations to achieve agility (e.g. IBM's 'On-Demand' vision and HP's 'Adaptive Enterprise' strategy). They provide a variety of organizational and technical solutions that should help to achieve the proper level of agility to handle unexpected waves of change.

However, as was clearly shown in a panel discussion on 'the agile enterprise' at MIT's CIO Summit (Schrage, 2004), there is by far no

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consensus as to what exactly agility is, nor on how one could assess and achieve agility. Very few studies have attempted to empirically study the need for agility. What are change factors requiring organizations to be agile and what is the relative importance of these factors? Moreover, research that assesses the current level of agility is scarce. The few studies we have identified that aim for this are generally limited in their sector focus (usually manufacturing) and research method (mostly only a questionnaire or single case study). This paper aims to define and empirically assess business agility and factors requiring agility. To achieve this, a framework is developed for analyzing agility and applied in four business sectors (Mobile Telecom, Finance, Utilities and Logistics). To obtain both breadth and depth of the analysis data are collected by using a comprehensive multiple method approach for data collection (multiple surveys and in-depth interviews).

### Research questions and approach

The overall research question of this paper is: What are the key internal and external change factors where businesses lack the necessary level of agility?

To address this question we will subsequently investigate the following sub-questions:

- What is agility and how is it different from the traditional concept of flexibility?

Our approach is to first develop a definition of business agility. Based on literature, we develop a conceptual model consisting of change factors requiring agility, enablers for agility and business-agility gaps. We selected a combination of quantitative (survey) and qualitative (interview) research methods to analyze the constructs in the framework. Based on these data, the key forces requiring business agility and the main agility gaps are determined. Next, using qualitative data collected in interviews, we explore the enablers, disablers and best practices for creating agility in the organization and business network. We then focus on the implications of business agility for IT. Finally, we explore main conclusions, implications, limitations and future research directions.

### What is agility?

#### Definition of agility

Even though much has been said and written on the subject, a consensus on a definition of agility has not yet emerged. First, the key commonalities and differences in concepts and definitions will be discussed; subsequently the definition we adopt for this study will be formulated. The definitions presented below summarize the variety of views on agility in the literature:

“Agility is the ability to thrive in a competitive environment of continuous and unanticipated change and to respond quickly to rapidly changing, fragmenting global markets that are served by networked competitors with routine access to a worldwide production system and are driven by demand for high-quality, high-performance, low-cost, customer-configured products and services (Goldman *et al.*, 1995).”

“Agility is primarily concerned with the ability of enterprises to cope with unexpected changes, to survive unprecedented threats from the business environment, and to take advantage of changes as opportunities (Sharifi & Zhang, 2000).”

“The ability of an organization to thrive in a continuously changing, unpredictable business environment (Dove, 2001).”

“The ability of an enterprise to develop and exploit its inter- and intra-organizational capabilities (Hooper *et al.*, 2001).”

“Agility is the successful exploration of competitive bases (speed, flexibility, innovation pro-activity, quality, and profitability) through the integration of reconfigurable resources, and best practices in a knowledge-rich environment to provide customer-driven products and services in a fast-changing market environment (Ramasesh *et al.*, 2001).”

“Agility is the continual readiness of an entity to rapidly or inherently, proactively or reactively, embrace change, through high quality, simplistic, economical components and relationships with its environment (Conboy & Fitzgerald, 2004, p. 37).”

- What are internal and external change factors that may require agility?
- For what change factors do today's businesses lack the required agility?
- What are enablers that can provide agility and in particular how can an agile IT architecture enable business agility?

From the definitions above some common aspects do come forward. Agility is a way to cope with external and internal changes, which are unpredictable or uncertain. Reasons for this can be three-fold. Unpredictability whether or when a certain event will happen, uncertainty what the effects will be (if a certain event will happen) and/or uncertainty about what the organization's re-

sponse will be (if a certain event happens). Some changes are quite predictable (e.g. deregulation in the telecom and energy sector); however, often the speed and exact requirements to the organization and processes are quite unpredictable.

*We know deregulation is coming and how it will change our market; however we do not exactly know how and when and which exact changes are required in our operations. Therefore we need agility in our processes and systems to be able to move quickly (Manager Energy Company).*

To be agile, companies need to be able to anticipate or respond to the changes in a timely manner and with ease. Responses are innovative rather than pre-engineered. Moreover, it is important to note that agility is relevant at two different levels: the enterprise level and the business network level. These two levels naturally interact. When the network around a company is agile, it will require the company to be agile too. Secondly, when the network is agile this will facilitate the enterprise to be agile. In a situation where the enterprise is the only agile link in the network, this will often inhibit the company to react appropriately.

### Flexibility vs agility

Dealing with change has always been an important issue in organizations. In areas where change is predictable and the response required can be largely predetermined, organizations need to be flexible. Volberda & Rutges (1999) define flexibility as 'the degree to which an organization has a variety of actual and potential managerial capabilities, and the speed at which they can be activated, to increase the control capacity of a management and improve the controllability of the organization' (Volberda & Rutges, 1999, p. 101). Volberda (1997) distinguishes three types of flexibility: operational flexibility (referring to reactive routines to familiar changes that are based upon existing structures or goals of the organization), structural flexibility (referring to the capacity of the management to adapt its decision and communication processes within a given structure as well as the rapidity by which this can be accomplished) and strategic flexibility (referring to capacity of the management to react in unstructured non-routine unfamiliar changes that have far-reaching consequences and need quick response).

To a large degree (operational and structural) flexibility can be engineered into an organization's processes and IT systems. Changing the parameters in a traditional ERP-package to accommodate for the occurrence of a predictable change is a good example of this. In other cases, changes can arise more unexpectedly and require a response that is unlikely to be predetermined. In such cases, flexibility cannot easily be engineered into the organizational processes and systems. Being able to act quickly both on the strategic and operational level to such unpredictable changes requires a new level of flexibility, which we refer to as *agility*. Agility therefore

can be seen to envelop and extend the concept of strategic flexibility (Overby *et al.*, 2005). Agility is needed when required changes were not envisioned when organizational processes and systems were established. As a result, more radical and innovative change is required such as modularizing or re-engineering existing processes and systems, acquiring or building new systems etc. Only organizations that can quickly and easily deal with this can be called agile.

Taking all the above considerations into account the definition of business agility in this study will be:

Business agility is being able to swiftly change businesses and business processes beyond the normal level of flexibility to effectively manage unpredictable external and internal changes.

### Conceptual framework

In this section, the conceptual framework and underlying elements are explained.

#### Framework introduction

Building on the work by Sharifi & Zhang (1999) we constructed a framework to analyze business agility in detail (see Figure 1). Factors that are taken into account are the general external environment factors (Politics, Economics, Society, and Technology) and Goldman's *et al.* (1991) four key agility dimensions: Cooperating to Enhance Competitiveness, Enriching the Customer, Mastering Change & Uncertainty and Leveraging the Impact of People and Information. In addition, in line with Yusuf *et al.* (2004), Van Hoek *et al.* (2001) and Mason-Jones & Towill's (1999) we explicitly regard companies not as isolated entities, but as part of a business network that affects the level of agility of the individual company. A business network-wide strategy to cope with turbulence in the business environment is considered eminent for all parties in the network. Therefore, we have added the business network dimension to the original model of Sharifi & Zhang (1999) via two enabling factors (business network governance and business network architecture).

Figure 1 shows our research model. It consists of three inter-related elements:

- *Change factors requiring agility*: These are internal or external factors influencing the required level of business agility. In our model, we have identified six categories of change factors requiring agility. These factors require businesses to adjust.
- *Agility gaps*: Agility gaps arise when the firm has difficulty in meeting the required level of agility (for a specific change factor) for changing from one state to another in a timely and cost-effective manner.
- *Agility enablers and disablers*: Agility enablers and disablers are the reasons behind the existence or non-existence of agility gaps. They are the means or barriers for a business to enhance business agility. In our model the enablers and disablers are organized in six categories.

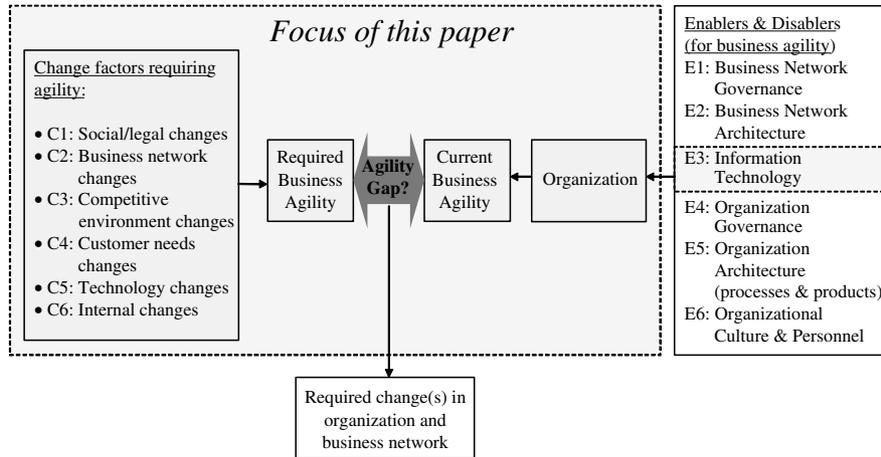


Figure 1 Research model for studying business agility.

Although our empirical study encompasses all three elements, in this paper, we will focus on the identification of important change factors requiring agility and agility gaps. Furthermore, we will briefly reflect on the implications for IT as enabler at the end of this paper.

**Change factors requiring agility**

In this study, we distinguish external and internal change factors requiring agility. External change factors are grouped into the following domains of external change (based on Sharifi & Zhang (1999): social/legal, business network, the competitive environment, changes in customer needs and technology. Internal change factors requiring agility are either required changes with unexpected consequences spurred by external change factors or distinct factors – internally initiated changes with unexpected consequences (e.g. a new strategy, a change in IT systems etc.) that require the organization to adapt fundamentally. Although initially, internal change factors that are unpredictable may sound like a paradox, in many cases large corporations have indicated that agility gaps emerged as a result of a new corporate strategy, newly defined performance indicators, a large merger or takeover or an organization-wide IT system implementation. Table 1 presents both external and internal change factor categories and examples of potential change factors within these categories, used in this study. All are based on earlier studies on agility and related topics.

**Methodology**

**Research methods**

The first phase in this research was a literature review and internet research. This literature review focused on business agility, developments in four selected sectors and agile IT. The literature review provided the necessary input to construct a survey. We used feedback of experts and two workshops to test and improve the survey. We did a cross-industry research study (like Daniel & Wilson,

2003) in four sectors as a basis for collecting empirical data. We have chosen different methods of data gathering in order to provide a rich picture on the topic. On the one hand we have gathered quantitative data via online surveys. This was complemented with in-depth qualitative data, gathered via interviews with executives and via workshops. The results were validated by interviews with sector experts and a (shorter) quick-scan survey among managers.

**Questionnaire**

We constructed a questionnaire containing 99 items in four parts covering the various elements of our research framework discussed above. A copy of the full questionnaire can be obtained from the researchers. The survey was hosted on a website in order to get a quick response. The digital output of the surveys was directly read into a database. Parts B (analyses of 65 external change factors) and C (analyses of 34 internal change factors) of the survey were built up dynamically. In part B and C various change factors requiring agility were presented to the respondent. To establish whether a change factor demands a company to change in the near future, each suggested change factor in the survey had to be scored on a Likert-5 scale. If the ‘probability of major business change outside the normal level of flexibility,’ due to a certain change factor was ‘high’ (score 4 or 5), a second question was posed regarding the ‘difficulty to cope with the required business change’ in the business network (also on a Likert-5 scale). If this question was answered with ‘very difficult’ (score 4 or 5), this change factor creates an agility gap. In the final part of the questionnaire, part D, for the top 10 agility gaps, open questions were generated. For each agility gap the respondent was asked to elaborate on the bottleneck(s) and measures taken with regards to the agility gap. This way, the questionnaire generated both quantitative data on the agility gaps as well as qualitative data on agility bottlenecks and enablers. We did a cross-check on possible survey fatigue which might bias our results. We

**Table 1** Overview of potential external and internal change factors requiring agility

<i>Change factor category</i>	<i>Examples of change factors requiring agility</i>	<i>Related literature references</i>
C1 Social/legal	<ul style="list-style-type: none"> <li>• Deregulation</li> <li>• Legal/political pressures</li> <li>• Increased need for financial transparency (e.g. IFRS)</li> <li>• Environmental changes and emergencies/disasters</li> </ul>	D'Aveni (1999) Gartner Research (2003) Sharifi & Zhang (1999) Kaptein & Wempe (2002)
C2 Business network	<ul style="list-style-type: none"> <li>• Competitors' mergers in the market</li> <li>• Takeovers by competitors</li> <li>• Consolidations in the business network</li> <li>• Partnerships and collaboration between competitors</li> </ul>	Porter (1980) Van Weele (2001) Best (2001)
C3 Competitive environment	<ul style="list-style-type: none"> <li>• Increasing pressure on cost in the market</li> <li>• Responsiveness of competitors to changes</li> <li>• Increasing rate of change in product models and product lifetime shrinkage</li> <li>• Threat of entry of new players</li> </ul>	Porter (1980) Sharifi & Zhang (1999) Swafford (2003)  Volberda (1999) Goldman <i>et al.</i> (1995)
C4 Customer needs	<ul style="list-style-type: none"> <li>• Demand for customized products and services</li> <li>• Need for quicker delivery time and time to market</li> <li>• Increasing expectation of quality</li> <li>• Sudden changes in order quantity and specification</li> <li>• Fundamental shifts in customer tastes</li> </ul>	Goldman <i>et al.</i> (1995) Sharifi & Zhang (1999) Da Silveira <i>et al.</i> (2001) Swafford (2003) Maskell (2001) Robben & Overstraeten (1999)
C5 Technology	<ul style="list-style-type: none"> <li>• Introduction of wireless connectivity</li> <li>• Emerging technologies to easily connect to partners' information systems (applications integration/middleware/messaging)</li> <li>• Increasing number of viruses</li> </ul>	Swafford (2003) Gartner Research (2003)  Vervest & Dunn (2000)
C6 Internal	<ul style="list-style-type: none"> <li>• Implementation of a new performance management system</li> <li>• Restructuring of internal IT systems and support</li> <li>• Internal strategy to be active in mergers and acquisitions</li> </ul>	Gartner Research (2003) Simon (2000)

found no difference in the range of answers between the first-half of the survey with the second-half. Furthermore, we checked the number of responses to individual items in the second-half of the questionnaire and compared it with the first-half. A few surveys were only partly filled in; these have been taken out of the sample for analyses.

### Selection of the sectors analyzed

We have chosen not to perform a broad random survey among businesses in all kinds of sectors, but to focus on a limited set of business sectors. With this approach we can get a far deeper insight into the factors determining change and the difficulties firms have coping with these changes. In particular, we have analyzed four sectors in the Dutch business community, each of which can be considered to be changing rapidly:

- Logistics (logistics service providers);
- Finance (retail banking);
- Utilities (distribution and sales of energy);
- Mobile Telecom (Mobile Telecom operators).

We have chosen these four highly dynamic business sectors, because they constitute an important segment of the total Dutch business community and these sectors are confronted with a wide variety of internal and external change factors.

### Data gathering and research sample

For the interviews with executives within each sector a sample of companies was selected. Criteria to select companies were their position in the market (top market share players, considerable size) and furthermore a number of new players were interviewed. Within each company at least two executives were asked to fill out the survey, as a basis for the in-depth interviews, which were held with at least two executives. One interview was held to cover the marketing perspective of business agility (mainly with CEOs and Marketing executives) and one to cover the operations and ICT perspective (mainly with COOs, CIOs and CTOs). The average duration of the interview was 90–120 min. Basis for the interviews were the agility gaps found in the survey and the main agility issues found in the sector research. From each interview

**Table 2 Research sample case studies**

Sectors	Finance	Mobile Telecom	Logistic service providers	Utilities (energy)	Total
Number of companies participated in interviews	7	4	6	4	21
Number of respondents filling out full surveys	10	11	8	8	37
Number of interviews with executives	13	8	9	6	36
Expert interviews	3	3	3	2	11

**Table 3 Research sample quick-scan surveys**

Sectors	Quick-scan respondents
Finance	67
Mobile telecom	17
Logistic service providers	12
Utilities (energy)	6
<i>Other</i>	
Industry	12
Government	25
Consumer packaged goods	6
ICT	12
Various	24
Total	181

minutes were taken and checked for accuracy with the interviewee. Table 2 provides an overview of the research sample for the case studies.

As a validation of the results found in the surveys and interviews and to gather data from more respondents within the four sectors, a shorter quick-scan version of the survey was sent out to a random sample of company contacts in different market segments (see Table 3).

We have used SPSS to analyze the quantitative data and we have organized expert sessions to extrapolate overall findings.

**Analyzing the urgency of agility gaps – agility gap ratio**

If businesses find it difficult to cope with major changes, which go beyond their normal level of flexibility, they are faced with a so-called agility gap. In order to analyze the urgency of the various change factors requiring agility an agility gap ratio was calculated from the survey results. Change factors requiring agility that have a high probability of fundamental changes (score 4 or 5) and a high difficulty to cope with (score 4 or 5) create an agility gap. In order to analyze the urgency of the various gaps we calculated an agility gap ratio by using the following formula:

$$Agility\ gap\ ratio_i = 4 * \left[ \frac{\sum_{j=1}^m \left( \frac{\sum_{k=1}^l p_{ijk}}{l} \right)}{m} \right] \left[ \frac{\sum_{q=1}^t \left( \frac{\sum_{r=1}^s e_{iqr}}{s} \right)}{t} \right] \%$$

with the following meanings:

$p_{ijk}$	The probability of business change, as indicated by respondent $k$ , from company $j$ , referring to change factor $i$ (only non-blank answers have been taken into consideration).
$e_{iqr}$	The difficulty to achieve business change, as indicated by respondent $r$ , from company $q$ , referring to change factor $i$ (only non-blank answers have been taken into consideration).
$i$	The change factor requiring agility concerned.
$j$	The company of the respondent who responded to the survey.
$k$	The individual respondent from company $j$ .
$l$	The number of respondents from company $j$ .
$m$	The number of responding companies.
$q$	The company of the respondent who responded to the survey with one or more individual respondent scoring $p_{ijk}$ (the probability of business change on change factor $i$ ) with a high score of 4 or 5 (only if the probability of business change scored 4 or 5 a question was posed to the respondent about the difficulty to cope with this business change).
$r$	The individual respondent from company $q$ scoring $p_{ijk}$ (the probability of business change on change factor $i$ ) with a high score of 4 or 5.
$s$	The number of respondents from company $q$ scoring $p_{ijk}$ (the probability of business change on change factor $i$ ) with a high score of 4 or 5.
$t$	The number of responding companies with an individual respondent scoring $p_{ijk}$ (the probability of business change on change factor $i$ ) with a high score of 4 or 5 (only if the probability of business change scored 4 or 5 a question was posed to the respondent about the difficulty to cope with this business change) (in case of a high agility gap ratio $m = s$ ).

The agility gap ratio has been scaled to a number between 0% (no gap at all) and 100% (largest gap possible). The higher the percentage, the more urgent the agility gap. In our visual representation of the agility gaps we have used *red* for most urgent gaps (ratio ≥ 60%), *orange* for high urgency gaps (ratio > 50 and < 60%) and *yellow* for gaps with a lower level of urgency (ratio > 40 and ≤ 50%).

**Findings**

In this paper, we will focus our findings on the assessment of the factors requiring agility and the agility gaps. The results of the study reveal a number of factors that generate *generic* agility gaps, present in all sectors under study, and a number of *sector-specific* gaps. We will report both types below.

**Generic factors requiring agility and gaps**

We have identified agility gaps which are generic, that is, gaps that are present in all four sectors. The top 15 generic agility gaps (with their respective category number) – based on their average agility gap ratio – are shown in Figure 2. The values represent the average gap ratio per change factor over the four sectors analyzed.

The emerging price war and the need for lower prices products and services are influencing all sectors analyzed. Companies have a lot of difficulties coping with the required changes. Lowering the prices requires another way of working and influences the way companies are

structured and operate. The top 15 generic agility gaps also indicate that most problems are found in the implementation of the (resulting) changing requirements in the own organization. To a large degree this can be explained by the existing legacy infrastructures (where increasingly more time and money are spent for maintenance & support). Figure 2 also indicates that the need for agility is not just created by unpredictable changes in the outside world. A lot of internal changes (like mergers and acquisitions and changes in systems and procedures) require organizations to become more agile as well (three out of six change factors in the top six are internal change factors, category C6).

**Sector-specific factors requiring agility and gaps**

When we compare the four different industry sectors we see a lot of differences and variety. The first observation in the Finance sector (Figure 3) is the fact that the price war is not the most dominant change factor requiring agility in this sector.

The financial sector has to deal urgently with several high impact regulations, where actual specifications and requirements become available rather late. Another gap occurs in meeting the need for multi-channel access. These gaps seem very much related to other gaps in the red and orange zone. The new regulatory and multi-channel demands put pressure on the huge legacy systems base. Attempts to handle these requirements increase costs. The apparent solution to outsource

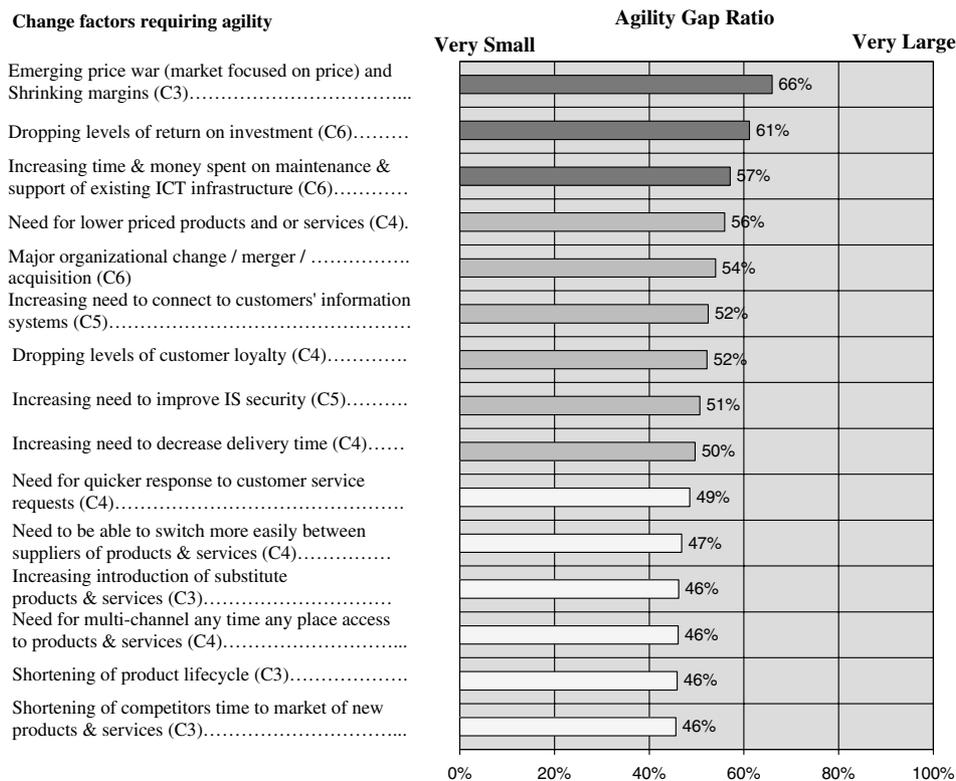


Figure 2 Overall agility gap top 15 (Source: Executive Survey).

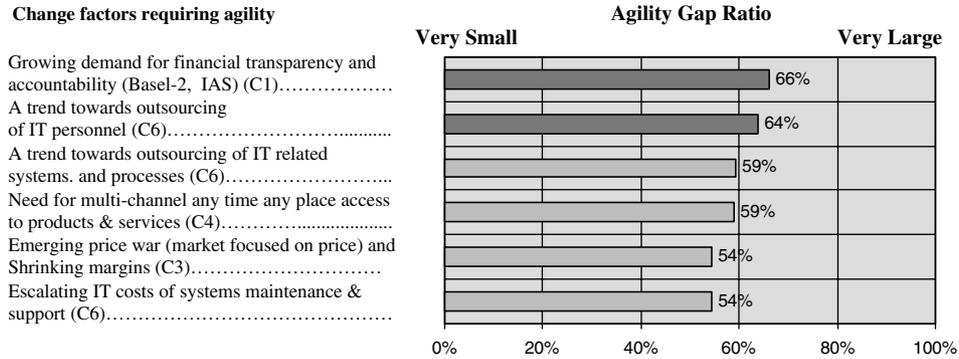


Figure 3 Overview of most urgent agility gaps for sector Finance.

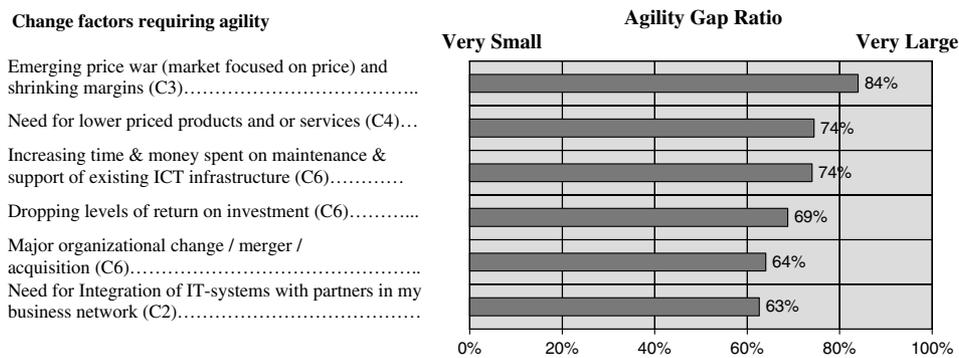


Figure 4 Overview of most urgent agility gaps for sector Logistics.

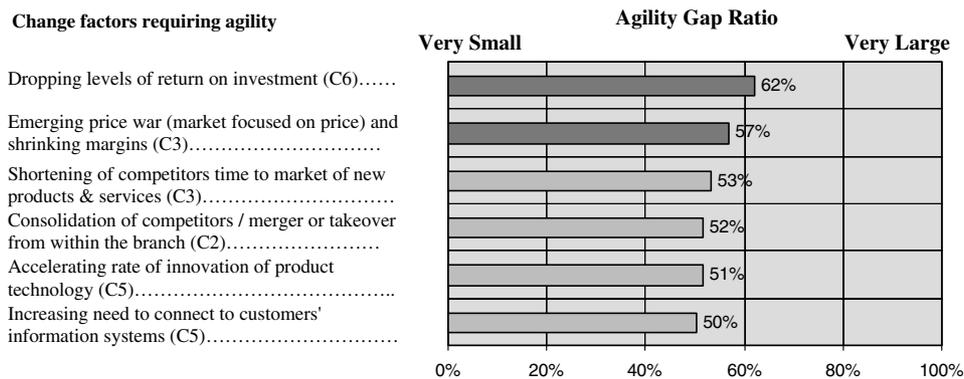


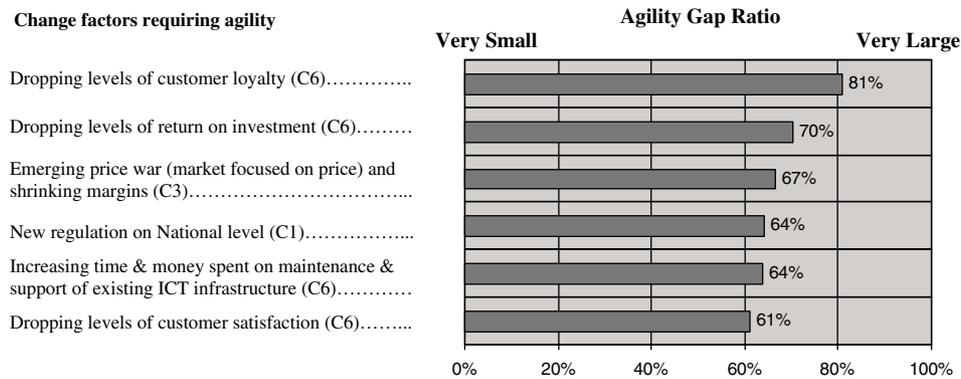
Figure 5 Overview of most urgent agility gaps for sector Mobile Telecom.

resources and personnel is complex and creates more gaps in dealing with this radical change in the organization.

The Logistics sector (Figure 4) is confronted with a high number of 'high urgency' agility gaps.

Owing to fierce competition in the commodity services, prices are under pressure. The consolidation trend has resulted in a large number of mergers and acquisitions. Economies of scale have been achieved, but also often a patchwork of IT and organizational architectures. As a result of the outsourcing trend logistics

service providers have often 'inherited' customers' logistics systems, or have to integrate tightly to these. Finally, the need for chain-wide tracking and tracing also requires integration to partners' information systems. Jointly, these developments have resulted in complex and heterogeneous IT architectures that need to be maintained and changed. As a result, new products, services and regulations require lots of resources in order to be implemented. Note that the gaps related to price pressure and systems integration and adaptation are severe (> 70%).



**Figure 6** Overview of most urgent agility gaps for sector Utilities (Energy).

The main gaps for the Mobile Telecom sector (Figure 5) seem to originate from the intensified competition.

New services have resulted in customized products and services that need to be put on the market in ever shorter time. The core systems to handle this variety of products cannot be adjusted quickly enough to implement the new requirements. Note that the gaps are not very severe (<70%) and that potentially disruptive innovations such as Wireless (WIFI) and IP telephony are only causing moderate gaps. It seems that the Mobile Telecom sector has over time developed best practices to cope with the rapid technological change.

The Utilities sector (Figure 6) is confronted with a high number of 'high urgency' agility gaps. These are a result of the new regulations that enforced the open market. Although this did not come as a surprise, still the impact may have been underestimated. The new phenomenon of having to worry about dropping levels of customer loyalty and customer satisfaction and a potential price war did create large gaps. IT infrastructures were never designed for processes needed in an open market. Organizational culture was more directed towards product quality than customer service.

### Business agility and the role of IT

As shown in our research model (Figure 1), IT can be both a change factor and an enabler or disabler for business agility. This section discusses the relationship between business agility and IT. The analysis presented here is based on the interviews with executives and remarks given by respondents to the open questions in the questionnaire.

The respondents confirmed that IT can both inhibit agility, as well as be a means to achieve agility. These results are in line with the analyses of Attaran (2004) on a number of BPR cases, where IT was the biggest barrier to rapid and radical change, because radical change required IS redesign. Often, within the same company, examples of both cases could be given. We will first elaborate on typical examples of IT as disabler for agility that were mentioned. Next, we present some best practices of IT

as an agility enabler. Finally, we point at some recent generic insights in how one can achieve an agile IT architecture that is well aligned to business-agility requirements.

### IT as a disabler for agility

Most enterprises we analyzed are entangled in large, complex information systems with hard coded embedded business processes and complex nests of links between applications, which often are organized into separate silo's of technology from different vendors. Changing requirements takes very long to implement and insufficient (IT) budget remains to be spent on innovation. Over the past 10 years companies have invested a lot of money in solving the millennium problem and the euro conversion. Less money has been invested in new IT platforms as a basis and enabler for change. In practice, companies and customers are frequently constrained by the limitations of the IT system.

Owing to the existence of inflexible legacy IT systems, an increasing amount of time and money needs to be spent on systems maintenance and support (resulting in high-agility gaps within Finance, Logistics and Utilities). Several agility gaps can be contributed directly to rigid IT architectures. For example, an executive of a major bank commented:

*International Financial Reporting Standards (IFRS) is not an accounting problem but an IT-problem. Providing detailed risk insight for many customers is impossible without changing IT-systems.*

Surprisingly, for another major bank, the IT architecture created in recent years caused more severe problems than the systems from the 1980s and 1990s. He commented:

*Our key concern are not our back-office systems that were created twenty years ago when technologies were relatively stable. Our main worries are maintaining and changing the recent front office systems implemented to support e-commerce and multi-channel customer access. The rich variety of technologies and*

*tools used, many of which are no longer supported, create enormous complexity.*

Managers stress that especially the unpredictability of the precise timing and impact of regulations demands agility in IT architectures. Although IT architectures may have been designed to offer certain flexibility, for example coping with foreseeable changes in business processes, the new requirements resulting from regulations have had drastic impact. One executive remarks:

*Basel 2 demands lots of changes in our legacy IT-systems to be applied and tested. Because of this, our most qualified people are now not able to work on more commercially necessary projects.*

An energy sector expert comments:

*Energy companies used to have integrated systems that have grown over the years to support most of their business functions. Quite suddenly, these systems now have to be split up vertically, as new regulation requires Chinese walls to be put up between the Retail, Production and metering function'. While the split up is being realized, at the same time, mergers in the energy sector call for horizontal integration.*

Such simultaneous cutting up and merging or replacing parts of legacy software systems results in unprecedented challenges to Energy companies.

Moreover, companies in the energy sector had to implement the marketing organization and its supporting CRM systems. As one IT manager comments:

*Our inexperience with marketing our products and the use of CRM systems makes these already complex CRM implementations even more challenging for us.*

The IT departments within these companies were used to a relatively stable environment and responded to the new requirements by hiring large numbers of consultants. However, the transition to a project organization and the often large differences in culture of the internal and external employees caused considerable difficulties in many cases.

The Financial sector is recognized for being among the first to have massively introduced software systems in the 1970s and 1980s. In many organizations these traditional architecture now hinders a transition to architectures that are more process and customer centric and that support multiple communication channels such as web-browsers and mobile phones. As the CIO of a large bank explains:

*We have recently had three large and critical systems development projects that have put a high strain on the organization. One aimed at bringing mobile banking to the customers, another was concerned with the launch of internet banking, and a third was an organization-wide roll out of a CRM package. In each of these, we have faced budget and schedule overruns, performance and scalability problems, etc. that could be largely contributed to the complexity of connecting these systems to our backend legacy systems. As a result our IT organization is now paralysed, and nobody seems to be willing to take on any new large scale projects.*

The complexity and sometimes outdated architecture of legacy systems may also explain why process and personnel outsourcing are causing gaps especially in the financial sector. One IT director comments on the challenges met when outsourcing a system offshore:

*We found that software code was insufficiently documented, and the documentation available was often outdated and written in the Dutch language. So we decided to send personnel offshore to sit next to the new system developers in what we call knowledge transfer sessions. Local personnel spent weeks or even months at the offshore site. Keeping our local IT people motivated in these operations has proven to be a difficult task.*

Finally, traditional IT architectures have usually been designed to primarily support internal business processes. Easily and quickly creating connections to external systems was never the original design intention, and as a result, is not straightforward. Although advanced enterprise integration platforms have become available, the lack of simple interfacing capabilities of the existing legacy systems as well as a lack of personnel that has experience in cross organizational integration projects makes this business-agility requirement hard to fulfil.

### **IT as an enabler for agility**

In our study, we also found cases where the on average highly ranked gaps did not occur. Often, the respondents pointed at an agile process and information system architecture as an important factor in preventing agility gaps.

For example, the COO and CIO of a telecom company explained to us that their relatively simple IT architecture had enabled them to deal with the ongoing price-war and the need to quickly implement new requirements:

*In telecom, as competition for big contracts is fierce, it's important to be able to quickly implement new contracts into your billing system. After having put great effort into setting-up a transparent and responsive IT-organization, simplifying and standardizing interfaces, and reducing the number of systems, we are now able to do this, I believe, faster than our competitors.*

A national branch of a foreign bank had the advantage of entering the Dutch market without carrying a heavy legacy. In setting up their processes and IT architecture, they focused on an efficient front-office that could easily interface to external administration offices. Their CEO explains:

*We specialize in loans and mortgages that we sell against very competitive interest rates. We can do this because we have a very lean organization. All mortgage contract administration is done by an external service provider to which we have interfaced our processes and systems.*

Another organization we analyzed is a relatively independent subsidiary of a multi-national bank. From the decision to enter the market until the first accounts were opened, time to market was only 7 months and 6 million in expenses. The IT architecture is based on the use of component technologies and a five-tier layered architecture. Customers can open an account online in

just 5 min. The bank uses an integrated business and technology approach, with a centrally orchestrated structure. One single department is in charge of IT strategy, operations management, security, compliance and governance. The infrastructure has been designed around the customer, utilizing a centralized database that supports all distribution channels. Sensing capabilities are implemented via risk and performance indicators for monitoring and improving systems and business solutions. Low operating costs and increased agility (short time-to-market) have given them significant competitive advantage and growth.

A multi-national logistics company has utilized its European expansion and the availability of low-cost high bandwidth network connections to set-up and connect process and IT Competency Centers. For example, one national site specializes in warehouse management and offers the functionality as services on the European network to other sites. Another site focuses on Fleet management etc. Using this strategy, the CIO has realized several advantages:

*We were able to reduce the number of different and redundant systems within the company, bundle expertise in competency centres, and operate in a more uniform way across Europe towards the customer.*

### The transition to an agile IT architecture

The examples of IT as an enabler and disabler of agility stress the need for organizations to implement an agile IT and process architecture in areas where business agility is required. Indeed, several respondents in this study were active to migrate to more adaptive and agile IT platforms and architectures.

However, what exactly is an agile IT architecture and how does one complete the transition? Several authors have described properties of agile IT architectures and the factors that drive the transition (Evgeniou, 2002). Konsynski & Tiwana (2004) observe that traditional organizational architectures are moving into spontaneous collaborative networks.

An agile IT architectures can be analyzed on four different levels of the business network – from lower to top level: hardware and systems software infrastructure, application software, management of an individual business and dynamic control and governance of the business network (Vervest *et al.*, 2005). All of these levels need to support integration and quick-connect and quick-disconnect capabilities to external partners (Goldman *et al.*, 1995; Sanchez, 1995). Furthermore, agile IT architectures should contain both sense and response capabilities, which are seen as key elements for enterprise agility (Dove, 2001). On the lower infrastructure level, agility can be incorporated on the basis of the concept of organic IT (Gillett, 2002). Forrester defines organic IT as *'computing infrastructure built on cheap, redundant components that automatically shares and manages enterprise computing resources – software, processors, storage, and networks – across all applications within a data centre.'* IBM

uses this concept in their *on-demand* strategy and HP in its *Adaptive Enterprise* strategy. By treating IT infrastructure like a utility, both storage capacity (via virtualization) as well as processor capacity (e.g. on the basis of grid computing) instantly can be changed, according to changes in demand. Via control tools sensing is achieved (due to increased visibility on the basis of drill-down and exception reporting), while respond capabilities are implemented by being able to quickly reconfigure the IT infrastructure (e.g. in case of capacity problems in a certain part of the physical network) by simply changing a number of relations in the control dashboards. In the mobile telecom sector, operators can quickly change the routing of data, if there are problems in a certain part of their network infrastructure.

At the organizational level, with agile one should not think of complete freedom to decentralized departments and business units to build or buy whatever system they need, nor of a rigid centralized system and inflexible IT department. Rather, agile IT architectures are designed for controlled change by using modern service architecture technologies and agile software development methodologies (like extreme programming). An agile IT architecture is a centrally orchestrated structure, based on a number of generic principles and guidelines. An agile IT architecture supports (the migration from batch processing to) event-driven processing.

On the application, management and business network levels the concept of the enterprise service bus (ESB), the next generation of enterprise application integration (EAI) provides a framework for a more agile IT architecture. Given the existence of legacy systems and variety of standards and protocols, various types of ESB middleware are needed as part of the agile IT infrastructure. Basic building blocks of the ESB are a service-oriented architecture with a high level of security (via digital signatures and encryption) and replaceable modular components. Interoperability is achieved via the usage of standards and open protocols and various types of ESB middleware and adapters for legacy systems.

At the near horizon, new technologies are emerging including swarm intelligence, pervasive tagging of objects via RFID, smart dust transmitters, control and reporting dashboards, and Business Rule Management Systems (BRMS). Again, these can enable more agile business networks but also become a future disabler if not properly introduced and managed.

Although the building blocks of agile IT architectures and examples described here sound appealing at the conceptual level, the road to achieving such agile architectures is filled with hurdles. So far, most companies have no or just a limited inter-firm or network perspective. To our surprise, the need for quick-connect capabilities within a business network was only expressed by a few executives in our study. Most of them were mainly focusing on the optimization of their internal (IT) operations. For new entrants, agile IT architectures are often within reach. However, for large established corporations, transforming

to an agile IT architecture is usually more challenging. The transition towards agile service-based architectures should thus not be underestimated, and expectations and planning should be carefully managed.

## Conclusions and recommendations

### Methodological conclusions and reflection

The overall research objective of this paper was to come up with a framework to analyze change factors requiring business agility and to measure the gaps between the current level of business agility and the level of business agility needed.

So far, there has been limited attention in literature on establishment of measurement frameworks for business agility (Dove, 2001; Overby *et al.*, 2006; Swafford *et al.*, 2006). We have chosen to develop a new theoretical framework based on a broad review of the literature, and to take a multi-method approach while making use of structured questionnaires and interviews to cover all important aspects. In our questionnaire we used two questions ('probability of major business change' and 'difficulty to cope with the change') to have respondents express their most urgent agility gaps. We used an agility gap ratio to assess the urgency of the various gaps. In our methodology, we measured the perception of the respondents with regards to gaps; we did not measure gaps on the basis of objective metrics. Although far from trivial, future research could focus on the development and application of a set of such metrics.

We analyzed enablers and disablers for business agility via interviews and qualitative free-text remarks of respondents to the questionnaires. This provided interesting qualitative insight into the enablers and barriers for achieving increased business agility. However, we did not construct a set of measures to objectively measure whether certain items were (perceived to be) a disabler or enabler for business agility.

As stated by Wadhwa & Rao (2003) the boundaries between flexibility and agility are blurred. We have made a first attempt to develop a questionnaire to assess the importance of change factors requiring agility in different business segments. Respondents were asked about the predictability of each category of change factors. One could argue that a more strict difference should be made between change factors, which require more flexibility *vs* change factors, which require more agility. On the other hand, although the probability of a change factor might be high, the predictability of necessary changes in the business in most cases is quite low. For instance the probability of expected changes due to government regulation in the energy sector was high, but the predictability of the timing and details regarding the necessary changes in the business and organizations systems and processes was rather low. Therefore, this change factor caused a high need for agility. Given the difficulty to cope with the change, this change factor posed an agility gap.

### Substantive conclusions with regards to change factors and agility gaps

What are the (main) gaps between the current level of business agility and the level of business agility needed in the four sectors? Based on the survey and interviews with executives we have come up with rankings of agility gaps per sector analyzed. The results show a number of gaps to be present in all four sectors. Furthermore, we found a lot of varieties between the four sectors analyzed. The emerging price war and the need for lower prices products and services combined with fast-changing customer requests is dramatically influencing all sectors analyzed. Companies feel severe difficulties in coping with the required changes. In many cases it requires a totally different way of organizing the company and its business network. Companies are very worried about the pace at which solutions can be implemented. To a large degree this can be explained by the existing organizational structures, cultures and legacy infrastructures. Executives in all sectors researched feel the unpredictability of government regulation and government measures forcing them to make their processes and systems more agile. Examples of such regulations are demands for more financial *transparency* and *accountability* (e.g. Basel 2, International Financial Reporting Standards (IFRS) and International Accounting Standards (IAS)), deregulation measures in the Utilities sector and EU Food Law regulations, containing clear requirements for traceability in the logistics and retail sector. Especially, the lack of implementation details and timing makes it necessary to implement the required changes in a short time-frame. The results also indicate that the need for agility is not just created by unpredictable changes in the outside world; often internal changes (like mergers and acquisitions and changes in systems and procedures) require organizations to become more agile as well. This is reflected in the relatively large number of change factors in category C6, which score relatively high as an agility gap. This finding is similar to Hackbarth & Kettinger (2004), who found the inability of firms to become net-enabled due to internal factors.

### Further research

This research was conducted in the period January 2004 till August 2004. The research was focused on four business sectors in the Netherlands. In order to gain more insight into the dynamics of business agility and the role of IT we have three recommendations for further research. In the first place, we recommend further refinement of the assessment instrument, taken causalities between relations into account, while measuring both change factors and enablers. We would like to measure the actual effects of specific agility enablers on the performance of individual organizations and in specific on the business network level. This would generate the necessary empirical evidence to create a benchmark as part of an agility barometer, where organizations could compare their agility score with

similar organizations in a business sector. Secondly, we recommend broadening the scope of the current research project to other countries. We expect that cultural and geographical differences influence the need for agility and level of business agility. An international benchmark would make it possible to compare the level of business agility and the competitive position of the Dutch business community with business communities in other countries. While this is desirable, it would take a lot of effort to arrange the data collection process and find enough respondents. Finally, more research is needed on the effects of agile IT architectures on the performance and agility of business networks as unit of analyses. The first examples of smart and agile business networks are appearing in practice (Vervest *et al.*, 2005), but more (empirical) research is needed to determine the effects

and impact of agile IT architectures, given the type of change factors requiring agility in a specific business segment.

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