

IS AGILITY RESEARCH: AN ASSESSMENT AND FUTURE DIRECTIONS

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Abstract

In this paper, we briefly describe IS agility related research in four established IS research areas: IT infrastructure, IS development, IS organization, and IS personnel. We present a systematic literature review of articles published in leading scientific IS journals during the years 1990-2013. The main contribution of the paper is in the summary of research methods and results of agility related research in the four research streams. Our analysis will provide researchers with a foundation of prior research when designing future studies. Additionally, the paper raises concerns that the dominance of two research streams (i.e., flexible IT infrastructures and agile IS development methods), may overshadow the role of IS personnel characteristics and IS organisation design in agility studies. Future IS agility research could also benefit from studies adopting a broader theoretical perspective to integrate concepts and findings across all four research streams.

Keywords: IS agility, IS flexibility, dynamic capabilities, literature review.

1 Introduction

Because agility is both difficult and critical for Information Systems (IS) organizations, it has intrigued researchers in several IS research streams. The value of this paper rests on the identification and re-examination of agility related studies carried out in four different IS research streams concerned with IS development; organization; personnel, and infrastructure. Agility related studies were identified in a systematic literature review, where literature was searched using keywords such as agility, flexibility and adaptability. This review led to a sample of 47 articles that explicitly address agility related themes in IS.

The paper begins with a short introduction to the concept of agility in management and organization research, followed by a brief summary of the use of agility concept in IS research. The paper then proceeds to describe how the literature review was carried out, with summaries of prior research being presented within the context of the four research streams. The paper is brought to a close with a summary of the theoretical and practical implications and contributions arising from this study.

2 WHAT IS AGILITY?

2.1 Origins of agility concept in management research

The concept of agility was first used in the strategic management and manufacturing literature in the early 1990s (Goldman and Nagel, 1993; Goldman et al., 1995). Agility was introduced into the literature with the argument that success in volatile industries requires a different set of capabilities than success in stable industries (Volberda, 1996; Volberda and Rutges, 1999). In such situations and industries, companies need to be agile – they need to be able to capitalize on or respond to the opportunities created by new market situations faster than their competitors (Goldman et al. 1995).

The key question then is, how can companies become agile – how can they build the required capabilities? And perhaps even more broadly – what exactly are these capabilities? This question has been addressed in several areas of strategic management and organization studies, rooting back to theoretical work that had started well before the concept of agility had been introduced.

Hence, there is an abundance of theories on strategic change that identify several alternative explanations for success. Among a number of examples, the dynamic capabilities literature emphasises the role of owners and managers in orchestrating fast business transformation (Teece et al., 1997). Agility originates from managers' capability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments (ibid., p. 515). Such high level capability can, however, also be seen as an outcome of routines and day-to-day practices that support strategizing between owners, senior management and other important strategy process participants, such as staff, business unit managers, and strategy consultants (Whittington 2006; Galliers 2007; Jarzabkowski and Spee, 2009).

There are, however, also theories that emphasise the role of professionals and middle level executives: according to those theories, strategic transformation is often contingent upon 'light touch' routines, mindfulness, bricolage and tinkering at relatively low levels of the organization (Eisenhardt and Martin 2000; Weick and Sutcliffe, 2006; Ciborra, 1992). These theories (among others) have been used as reference disciplines in IS agility research.

2.2 Use of the agility concept in IS research

In IS research, the concept of agility has increasingly been used in combination with terms such as flexibility, dynamic and organic. IS practitioners adopted the idea of "agile programming" in the early 1990s and it still dominates the interpretation of agility on the part of many IS professionals. In research, the concepts of flexibility and agility have been related to the broader challenge of combining complex IT systems with unexpected, sometimes surprising changes in user needs, business processes, company structure, strategy, markets and society at large.

In various IS research streams, there is the potential to add the sub-question: our results appear to apply in "normal conditions", but what about the "volatile environment"? Hence, while reviewing the literature, we identified many streams of research where the relationship between IS and organizational change has been addressed. When classifying these papers according to the research question, we used a tentative classification into seven different groups that seemed appropriate and sufficient for identifying similar papers (See table 1).

Field of Research	Relation to flexibility/agility
Strategic IS management	How the CIO and the senior management should make top-level decisions about IT in a volatile or turbulent environment?
Business agility and the value of IS applications	What is business agility and how do IS applications (e.g. DSS, CRM; SCM; BI; KMS) promote business agility e.g. by supporting rapid sensing and responding?
Design of IT infrastructure	How the IT infrastructure should be designed and maintained in order to enable timely support for rapid business changes?
Skills and competences of IS professionals	What kind of skills and competences of IS professionals are critical in the context of rapid business changes?
Design and governance of the IS organization	How should the IS organisation (including IS outsourcing relationships) be structured and governed to support rapid and continuous business change?
Methods used in IS development	What kind of methods should be used in IS development projects to deal with ambiguous and evolving business requirements?
Methods used in SW development and programming	What kind of methods should be used in software development and programming to deal with ambiguous and evolving system's requirements.

Table 1. Typology created while classifying IS agility/flexibility studies (Rows highlighted with stronger borders identify research streams selected for this paper).

Although the streams share the interest to understand agility, often drawing from the same reference disciplines, each research stream has selected and defined its key questions and concepts. Even within the same stream, there is often more than one definition for agility, and concepts like agility, flexibility, organic or dynamic have been used interchangeably.

2.3 Selecting the focus for this study

The rationale for selecting the four streams (IT infrastructure, IS development, IS personnel and IS organisation) is that they address tasks that are controlled by the IS function and thus deal more directly with change capabilities of the IS organisation. The three excluded areas (strategic IS management; business agility and IS, and agile software development) are all sufficiently extensive research areas to deserve a literature review on their own (see, e.g., Tanriverdi et al. 2010; Overby et al. 2006; Dybå and Dingsøyr 2008). We do recognise, however, the close relationship between all seven areas.

3 Study design

The aim of this literature review was simple: to identify studies from prior IS research that address agility in the IS organisation context. In the following, we present details of how the literature review was undertaken.

The review took the form of a five-phase approach as recommended by Webster and Watson (2000). In the first phase, relevant articles were searched from leading journals in the IS and management arena, including all the AIS 'basket of eight' journals, six other high quality scientific journals (Database for Advances in Information Systems; Decision Sciences; Decision Support Systems; Information & Management; International Journal of Information Management; Management Science) and four prac-

tioner-oriented journals (Communications of the ACM; Harvard Business Review; Information Systems Management; Sloan Management Review).

Because there are many synonyms for agility that appear in the literature (see Sherehiy et al. 2007), several keywords and search fields were used to ensure comprehensive coverage. The keywords used, based on Sherehiy and colleagues, were: agility; agile; flexibility; flexible; adaptability; adaptive, and organic. In the case of business journals, the keyword “information system” was used to limit the search to the IS field. Articles were searched by the title, abstract and full text fields. Results were limited to articles published from 1990 onwards.

The second phase comprised screening the articles based on: first by title, then by abstract and finally by full text, to identify papers that address agility related themes in the context of the IS organization. The third and fourth phases complemented the search by reviewing the citations in the articles identified as a result of the screening done in the first two phases, and then by utilizing the Web of Science citation index to identify and review subsequent literature that referenced the articles found in the three first phases.

In the fifth and final phase, the articles were classified. The first classification was based on the research question, which led to the identification of the four research streams. Within each stream, further classifications were then made according to the study design, distinguishing between studies where the key contribution is related to: (1) definition or measurement of key agility/flexibility variables; (2) antecedents of agility/flexibility variables, and (3) organizational impact or value of the agility/flexibility variables. (A recent update search this winter identified some additional articles. We were not able to include those to the paper, but they will appear in the conference presentation).

4 Results

In the following, the articles within each research stream are briefly described. The objective is to summarise research in each stream by presenting key definitions and main findings regarding antecedents and value of flexibility/agility.

4.1 Research stream: IT infrastructure

Research in IT infrastructure flexibility has benefited from the early conceptual work, first by Duncan (1995) and later by Byrd and Turner (2000). Although Duncan does not give a precise definition, the following description provides a starting point for understanding IT infrastructure flexibility:

Infrastructure flexibility determines the ability of the IS department to respond quickly and cost-efficiently to systems demands, which evolve with changes in business practices or strategies. The ideally flexible infrastructure would be one that was designed to evolve, itself, with emerging technologies and would support the continuous redesign of business and related processes (Duncan, 1995, p. 44).

Later, Byrd and Turner (2000) developed a measurement instrument for IT flexibility. The instrument was based on the assumption that IT infrastructure flexibility consists of eight dimensions: four in the technical base (IT connectivity; applications functionality; IT compatibility; data transparency), and four in the human component (technology management; business knowledge; management knowledge; technical knowledge).

One aspect of research on IT infrastructure flexibility has identified practices that are intended to lead to this flexibility (see table 2). The main lesson from these studies is that systematic architectural thinking – as described in, for example, enterprise architecture or service oriented architecture – is a prerequisite for flexible IT infrastructure (Allen and Boynton, 1991; Schmidt and Buxmann, 2011; Joachim, Beimborn, and Weitzel, 2013). New technological trends can constitute both a means to (Fink and Neumann, 2009) and a challenge (Benamati and Lederer, 2001) for IT infrastructure flexibility.

Definition and measurement of flexible IT infrastructure		
Duncan, 1995 (JMIS)	Group and semistructured interviews: high-level IS executives	Presents a framework for developing tools to evaluate infrastructure flexibility.
Byrd and Turner, 2000 (JMIS)	Survey: IS senior managers in Fortune 1000 companies	Defines the IT infrastructure flexibility construct and develops a valid, reliable measurement instrument for this construct.
Antecedents of IT infrastructure flexibility		
Allen and Boynton, 1991 (MISQ)	Conceptual: (research, case writing, and consulting experience)	Recommends a combination of centralised (high road) and decentralised (low road) solutions to face the dual challenge of "speed and flexibility" and "low cost and efficiency."
Benamati and Lederer, 2001 (CACM)	Survey: A field survey among IS professionals in the USA.	Describes the use of coping mechanisms with which IT organizations adapt to rapid IT change.
Fink and Neumann, 2009 (DB)	Survey: 293 IT managers in Israel, cross-sectional.	Results show that the implementation of Web services applications positively affects the flexibility of IT infrastructure and information flexibility.
Schmidt and Buxmann, 2011 (EJIS)	Survey: financial services, EU, North America and Australia	The implementation of an Enterprise Architecture Management function is supportive in the creation and sustainment of IT efficiency and IT flexibility.
Joachim, Beimborn, and Weitzel, 2013 (JSIS)	Survey: 81 IT managers in SOA using organisations in Germany	Identifies SOA governance mechanisms that effect infrastructure flexibility and reuse of services.

Table 2. Studies addressing the definition, measurement and antecedents of flexible IT infrastructure.

Other researchers have tested hypotheses related to various positive business impacts and benefits of flexible IT infrastructure (Table 3). These studies have been able to associate IT infrastructure flexibility with, for example, rapid business process changes (Broadbent et al., 1999); success in global IT projects (Lim et al., 2006); sustained IT alignment (Tiwana and Konsynski, 2010); improved organisational responsiveness (Bhatt et al., 2010); strategic payoffs (Fink and Neumann, 2009); competitive advantage (Bhatt et al, 2010), and ultimately, firm performance (Kim et al., 2011; Liu et al., 2013).

Value of IT infrastructure flexibility		
Broadbent, Weill and St.Clair, 1999 (MISQ)	Exploratory case: four firms (retail and petroleum).	Firms with higher level of IT infrastructure capabilities were able to implement extensive (more innovative and radical) changes to their business processes over relatively short time frames.
Lee, Banerjee, Lim, Kumar, van Hillegerberg, and Wei, 2006 (CACM)	Case study: large life and casualty insurance company.	Synergistic use of agile IT strategy, agile IT infrastructure, and agile IT project management contributed to a highly successful globally distributed system development project.
Fink and Neumann, 2009 (I&M)	Survey: Data collected from 293 IT managers in Israel.	Achievement of perceived strategic payoffs of IT infrastructure enabled flexibility was explained by range of managerial IT infrastructure capabilities, and IT personnel knowledge and skills.
Bhatt, Emdad, Roberts and Grover, 2010 (I&M)	Survey: senior executives of 105 manufacturing and service firms.	IT infrastructure flexibility was positively related to information generation and dissemination, leading to improved organizational responsiveness and firm's competitive advantage.
Tiwana and Konsynski, 2010 (ISR)	Survey: 223 organizations (MIS and line managers).	IT architecture modularity helps sustain IT alignment by increasing IT agility. Decentralization of IT governance strengthens this relationship.
Ngai, Chau, and Chan, 2011 (JSIS)	Multiple case study: fashion and textile industries in Hong Kong.	Provides partial support for propositions that IT integration and IT flexibility are positively associated with supply chain agility.
Kim, Shin, Kim, and Lee, 2011 (JAIS)	Survey: Managers in Korean companies.	Results confirm the following route of causality: IT personnel expertise -> IT management capabilities -> IT infrastructure flexibility -> process-oriented dynamic capabilities -> firm financial performance
Liu, Ke, Wei, and Hua, 2013 (DSS)	Survey: 286 executives (e.g., CIO, CTO or COO) in China.	Survey data show that IT capabilities (i.e., flexible IT infrastructure and IT assimilation) affect firm performance through absorptive capacity and supply chain agility.

Table 3. Studies addressing the value of flexible IT infrastructure.

Articles on IT infrastructure flexibility have been published in the leading IS journals (mainly 'basket of eight' journals), which provides an indication of the quality of these articles. Survey research has been the dominant research method in this stream. Although the distinction between antecedent variables, the definition of IT infrastructure flexibility variable, and various outcome variables is not entirely consistent, this research stream appears to form a genuine research area, where knowledge of the theme (flexible IT infrastructure) accumulates over time.

4.2 Research stream: IS development

In the IS development (ISD) research stream, agility related research has focused on the use of agile methods. Conceptual research has helped in defining key variables for research. Lee and Xia (2005) developed measurement scales for the two central components of ISD flexibility: response effectiveness and response efficiency. Later, based on a comprehensive review of the use of the concepts flexi-

bility, agility and leanness in business studies, Conboy (2009) defines agility of an ISD method as follows:

The continual readiness of an ISD method to rapidly or inherently create change, proactively or reactively embrace change, and learn from change while contributing to perceived customer value (economy, quality, and simplicity), through its collective components and relationships with its environment. (Conboy, 2009, 340).

Several case studies have then tried to identify antecedents for flexibility or agility in ISD (Table 4). A central thesis is that companies should follow the principles of the so called agile ISD methods (Baskerville and Pries-Heje, 2004; Sarker and Sarker, 2009). It has, however, been recognised that the adoption of such methods is a slow learning process (Cao et al., 2009; Berger and Beynon-Davies, 2009; Wang et al., 2012). Many other variables, such as organizational context, various project attributes, and collective and individual mindfulness define project teams' ability to e.g. effectively deploy agile principles (Lyytinen and Rose, 2006; Zheng et al., 2011; Ramesh et al., 2012; Goh et al., 2013).

Definition and measurement of ISD Agility		
Lee and Xia, 2005 (EJIS)	Survey: Confirmatory factor analysis data from 505 ISDP managers	The study developed measurement scales of ISD project team flexibility along two dimensions: Response Extensiveness and Response Efficiency.
Conboy, 2009 (ISR)	Systematic literature review and case study (2 ISD projects).	The study develops a definition and formative taxonomy of agility in an ISD context, to be used as a starting point to study ISD method agility.
Antecedents of ISD Agility		
Baskerville and Pries-Heje, 2004 (ISJ)	Case study: 9 companies in the U.S. and 3 in Denmark.	Studies reveal that short cycle time systems development is a new form that can be clearly distinguished among other forms, based on five SD practices.
Sarker and Sarker, 2009 (ISR)	Case study: a multinational high-tech organization.	Agility in globally distributed ISD should be viewed as a multifaceted concept having three dimensions: resource, process, and linkage agility.
Zheng, Venters, and Cornford, 2011 (ISJ)	Case study: UK's computing grid for particle physics (GridPP)	This paper offers insights and implications for 'collective agility' in a global collaborative SD community through the dynamics of six improvisation paradoxes.
Ramesh, Mohan, and Cao, 2012 (ISR)	Case study: a multisite case study of three projects	Examines how case organizations developed contextual ambidexterity—the ability to pursue conflicting demands of agility and formality of distributed ISD simultaneously.
Wang, Conboy, and Pikkarainen, 2012 (ISJ)	Exploratory case study: Four ISD teams in different organizations.	Applies innovation assimilation stages to understand the acceptance, routinisation and infusion of agile practices by ISD teams.
McAvoy, Nagle, and Sammon, 2013 (ISJ)	Longitudinal case study: a 16 month study in an ISD organisation	The study explores the use of mindfulness as a theoretical framework to examine ISD agility, thus providing contributions around the value of mindfulness for ISD agility.
Lyytinen and Rose, 2006 (EJIS)	Multi-site longitudinal case study: seven ISD companies.	Describes ways how ISD organizations' practices changed from exploration (innovation) to exploitation (cost, risk and product quality) while innovating with Internet computing.

Cao, Mohan, Xu, and Ramesh, 2009 (EJIS)	Case study: semistructured interviews in four ISD projects.	Using adaptive structuration theory as a lens, the paper describes how the structure of agile methods, projects, and organizations affect the adaptation of agile methodologies.
Berger and Beynon-Davies, 2009 (ISJ)	Longitudinal ethnographic case study: a UK public sector organization.	Demonstrates problems experienced with the adoption of rapid application development, particularly in stakeholder involvement, suggesting that ISD method adoption is a dynamic and continuous process.
Goh, Pan, and Zuo, 2013 (JAIS)	Case study: IS projects in Beijing Capital International Airport.	IT project team capabilities and organizational control mechanisms are central in defining agile IS development practices in large-scale IT projects.

Table 4. Studies addressing the definition, measurement and antecedents of agility in IS development

Some of the studies on agile ISD have also focused on the outcomes resulting from the use of agile ISD principles (Table 5). In the Holmqvist and Pessi (2004) case study, the use of short projects with comprehensible size is carefully linked to the successful business outcomes of the project. Other researchers have linked dimensions of agility practices into the more traditional ISD success measures (Sarker et al., 2009). Related to this, one study measured user satisfaction and intention to continue using systems that are under continuous development (Hong et al. 2011).

Value of Agility in IS development		
Holmqvist and Pessi, 2006 (EJIS)	Case study: Volvo's global initiative to sell spare parts over the Internet.	Demonstrates how agility in IS development through continuous implementation and comprehensible sized projects enabled innovation through new relations and channels.
Sarker, Munson, Sarker, and Chakraborty, 2009 (EJIS)	Analytic hierarchy process: 8 respondents, technical and managerial.	Assesses the relative importance of the various types of agility types/facets with respect to different ISD success measures. Presents three ways to aggregate the preferences of the two groups (managerial and technical).
Hong, Thong, Chasalow, and Dhillon, 2011 (JMIS)	Survey: Fortune 500 company in the service industry, data from 477 users.	Utilizes constructs from e.g. UTAUT to explain users' intentions to use new features when they are released (surrogate for the ultimate success of agile IS).

Table 5. Studies addressing the value of agility in IS development

In addition to agility in the ISD process, flexibility can be built into the systems and their use processes (Table 6). Sometimes such flexibility results from conscious choices in systems design (Gebauer and Lee, 2008), but it can also result from users finding workarounds and stretching their work process rules in the context of existing systems (Goh et al., 2008; Azad and King, 2008). Gebauer and Schober (2008; 2011) have also studied the value of designed flexibility through conceptual modelling and simulation.

Antecedents of flexibility-to-change vs. flexibility-to-use		
Goh, Gao, and Agarwal, 2011 (ISR)	Longitudinal field study: health care organisation.	Provides understanding of the interplay between technology and patterns of clinical work embodied in routines. Proposes a dynamic process model of co-evolution.
Gebauer and Lee, 2008 (ISJ)	Case study: an electronic procurement system at a Fortune 100 firm.	Presents a roadmap that can guide flexibility and implementation strategies of enterprise systems based on both project and business process characteristics.
Azad and King, 2008 (EJIS)	Case study: Mediterranean teaching hospital.	The hospital's organizational environment allows for interpretive flexibility, in which physicians stretch rules to make adjustments to existing computer-based procedures.
Value of flexibility-to-change vs. flexibility-to-use		
Gebauer and Schober, 2006 (JAIS)	Conceptual modelling: flexibility-to-use and flexibility-to-change.	Flexibility-to-change is cost efficiently deployed to support a business processes with high structural and environmental uncertainty, whereas a low process uncertainty corresponds with IS flexibility-to-use.
Schober and Gebauer, 2011 (DSS)	Simulation experiment: value of IS flexibility.	A deterministic treatment of IS flexibility underestimates its value, whereas ROA can overestimate it. Findings highlight the need for the concrete measurement of IS flexibility.

Table 6. Studies addressing flexibility-to-change and flexibility-to-use

Overall, research on agility in ISD is predominantly based on case research, supported by only few surveys and conceptual/analytical papers. Perhaps related to this, most of the 20 papers in this stream are published in three journals: European Journal of Information Systems (6), Information Systems Journal (6), and Information Systems Research (4). Hence, also this research stream forms a genuine research tradition, accumulating knowledge towards a more detailed theory of the theme (Agility in IS development).

4.3 Research stream: IS personnel skills and competences

Skills and competences of IS personnel have been acknowledged as critical components of both flexible IT infrastructures and agile IS development. There are, however, two studies in our sample that address the capabilities of IS professionals more broadly than just in relation to IT infrastructure or ISD (Table 7). The starting point of these papers is that IS professionals will need change-agent capabilities (Markus and Benjamin, 1996) and mindfulness in dealing with surprising events (Butler and Grey, 2006). Papers argue that organizational structures and standardised roles and work practices may prevent IS professionals from adopting a more effective change agent role or to act mindfully in surprising situations.

Antecedents of change-readiness among IS personnel		
Markus and Benjamin, 1996 (MISQ)	Conceptual: IS specialists as agents of organizational change.	Describes the traditional change-agent role that is very commonly held by IS specialists. While well-intended and supported by structural conditions in IS work, it often has negative consequences for organizations and for the credibility of IS specialists. Proposes an alternative to the traditional role.
Butler and Gray, 2006 (MISQ)	Conceptual: the concept of mindfulness.	Considers a variety of implications of mindfulness theories of reliability in the form of alternative interpretations of existing knowledge and new directions for inquiry in the areas of IS operations, design, and management.

Table 7. Studies addressing antecedents of change-readiness among IS personnel

Both papers are published in MIS Quarterly, which can be seen to be illustrative of the significance of the topic. Although neither of the papers provides empirical evidence, the studies do open the question of the role of IS personnel competences and skills in agility. Clearly, future research could focus on this issue, also outside the context of flexible IT infrastructure and agile IS development.

4.4 Research stream: IS organization design

Several researchers have also recognised the role of IS organisational structures and governance mechanisms of both internal functions and IS outsourcing relationships. Clark et al. (1997) provide the following definition for a change-ready IS organisation:

Change-readiness is the ability of an information systems (IS) organization to deliver strategic IT applications within short development cycle times by utilizing a highly skilled internal IS workforce. (Clark et al., 1997, p. 425)

Requirements for IS organisation have been addressed in several conceptual papers (Table 8). One of the key antecedents for a flexible IS organisation is a partner relationship between the IS organisation and the business (Rockart et al., 1996). IS departments are advised to adopt a matrix organizational structure – one that enables managing technical knowledge as a competence centre but simultaneously supports customer-driven development and service processes. Often referred to as a Centre of Excellence structure (Clark et al. 1997; Boar 1998; Gerth and Rothman 2007), it enables the critical requirement of distinguishing technical and control oriented tasks from business development oriented tasks. In general, an IT organisation should aim at becoming an emergent organizing and create virtual teams to promote close collaboration with business units (Prager, 1996; Truex et al., 1999). An empirical study by Clark et al. (1997) provides support for these propositions: transformation of an IS organization to a Centre of Excellence structure led to improved customer satisfaction, satisfaction with projects and higher percentage of projects being delivered on time for example (Clark et al. 1997).

Antecedents of flexible IS organization design		
Prager, 1996 (ISM)	Conceptual: aligned IT organization, implications for IT professionals.	The IT function should assume a new role of anticipating and meeting the infrastructure and information needs that support organizational flexibility.
Rockart, Earl, and Ross, 1996 (SMR)	Conceptual (Field studies in the U.S. Europe and Japan)	Explores changes in business and technology that are driving changes in the role and structure of IT units. Defines and discuss eight "imperatives" for IT organizations in responding to these changes.
Boar, 1998 (ISJ)	Conceptual: IT structures vs. rapid horizontal introduction of IT.	An organizational structure that combines the ideas of mini-businesses and the internal marketplace can provide a dynamic balance between stability and productivity and flexibility and innovation.
Truex, Baskerville, and Klein, 1999 (CACM)	Conceptual: emergent organizations, practices in the IT organization.	Introduces organizational emergence as a new theory of social organization. Uses the theory to describe influences for the IS practices and organisational design.
Gerth and Rothman, 2007 (ISM)	Conceptual: business changes, IS organization and IS capabilities.	Describes how the business world is becoming increasingly "flat" with regard to access to global markets and a global workforce. Argues that new emerging operational priorities require new IS capabilities.
Value of flexible IS organization design		
Clark, Cavannaugh, Brown and Sambamurthy, 1997 (MISQ)	Case study: IS unit at Bell Atlantic, a Regional Bell Operating Company.	Describes the transformation process to the Center of Excellence design in an IS organisation. Proposes it as a model worthy of consideration by other IS managers for developing change-readiness IT capabilities.

Table 8. Studies addressing flexibility in IS organization design

Articles addressing the IS organisation are published mainly in practitioner and management oriented IS and business journals. Although authors sometimes refer to their prior empirical work or consulting, no empirical data are presented. Articles are carefully written to provide instructions for managers on how to develop "a new IS organization", indicating that the existing IS organisations are not sufficiently prepared for change. Although articles provide generic advice on various facets of IS management and work, they also raise a clear argument that the design of the IS organization may influence its ability to cope with change.

In addition to the internal IS organisation, the need for flexibility has also been recognized in research on IS outsourcing relationships (Table 9). Tan and Sia (2006) define IS outsourcing flexibility as follows:

"To cope with the dynamic environment, an outsourcing relationship should be capable of change or adaptation. Outsourcing flexibility is thus about the ability of an outsourcing relationship to change the extent, nature, or scope of business services delivered" (Tan and Sia, 2006, p. 184).

Studies on flexible IS outsourcing have identified a large array of strategic and tactical manoeuvres and discussed their implications for IS success (Lacity et al., 1995; Tan and Sia, 2006; Sia et al., 2008)

One specific manoeuvre, a dynamic outsourcing contract, appears to be a significant antecedent for IS outsourcing flexibility and beneficial in conditions of unforeseen changes (Susarla, 2012).

Definition and measurement of flexible IS outsourcing		
Tan and Sia, 2006 (JAIS)	Conceptual: Clarifies the multi-dimensional notion of flexibility.	Identifies four dimensions of outsourcing flexibility (robustness, modifiability, new capability, and ease of exit).
Antecedents of flexible IS outsourcing		
Lacity, Willcocks and Feeny, 1995 (HBR)	Conceptual (Field study: 40 large corporations and public-sector organizations in the U.S. and Europe).	Concludes that the "strategic-versus commodity" approach to outsourcing led to problems in ensuring IS outsourcing flexibility and control. Proposes a new framework.
Value of flexible IS outsourcing		
Sia, Koh and Tan, 2008 (Decision Sciences)	Survey: 171 outsourcing projects in Singapore.	Links the four dimensions of outsourcing flexibility (robustness, modifiability, new capability, and ease of exit) to different strategic maneuvers and IS outsourcing success.
Susarla, 2012 (Management Science)	Document analysis: 141 IT outsourcing contracts.	Building upon literature on incomplete contracts, posits that renegotiation can be Pareto improving by incorporating contingencies revealed ex post.

Table 9. Studies addressing flexibility in IS outsourcing

Studies that explicitly address flexibility in IS outsourcing remain few. Nevertheless, in particular the studies by Tan and Sia (2006) and Sia et al. (2008) provide a sound conceptual basis for further studies on this subject.

5 Discussion

Research on IS agility and flexibility originated in the 1990s with conceptual papers that addressed new demands for the IS organization and IS personnel. Papers in managerially oriented journals (HBR, SMR, ISM) argued for a need for a new IS organisation, which is better prepared to deal with change. The role of IS personnel as a change agent was also recognized in a MISQ commentary article. These arguments were not, however, rooted to empirical research (with the exception of Clark et al. 1997).

After the year 2000, the original emphasis on IS organisation and IS personnel was, however, replaced by research that explains agility through the attributes of IT infrastructure, IS development methods, and IS outsourcing practices. Researchers in each stream rely on similar research methods and they also share the journals where they publish results: flexible IT infrastructure studies are largely based on survey research and results are often published in leading AIS 'basket of eight' journals; case research on agile IS development tends to be published in three journals (ISR, ISJ and EJIS) and the research stream on flexible IS outsourcing, which is only emerging, has been initially published in Management Science, Decision Sciences and JAIS.

Research on IS agility has thus been divided into three established IS research areas: IT Infrastructure, ISD, and IS outsourcing. An advantage of this "sub-stream approach" is that researchers can utilise concepts and frameworks of existing IS research traditions. By addressing "special conditions", they

make a sufficient contribution to be able to publish their results in high quality journals. Because the focus is on one specific IS task, the results are also specific and thus useful and easy to communicate for practitioners.

The disadvantage is related to the lack of an overall view on IS agility and the duplication of work done in different research streams. It is difficult to avoid the impression that there is a lot of similarity in central arguments regarding antecedents and value of IS agility in different domains. It is also easy to share concerns raised by Conboy (2007) about lack of clarity, theoretical-glue and conceptual parsimony, not only in the agile IS development research stream, but across all research streams covered in this review.

6 Limitations

The research task underpinning this literature review was simple: to identify articles from prior IS research that address questions concerning the agility of the IT organization. The fact that we reviewed literature from several large IS research fields (rather than investigating a single field) added challenges to conducting the review. Some articles could have been classified into more than one research stream and there were borderline cases where the screening decision was not obvious. Focusing the review on journal publications left relevant books (e.g., Desouza, 2007) and scientific conferences outside the scope of the review. Important articles and findings may therefore have been omitted (cf. Galliers and Whitley, 2007). Nevertheless, we believe that the articles in leading IS journals and their findings presented above provide a reasonably representative sample of mainstream research related to IS agility.

7 Assessment and future directions

It seems likely that research around flexible IT infrastructures and agile IS development methods will continue to enrich theories and explanations for agility, as both streams have reached a critical mass of researchers and publications. These research streams do not completely ignore the role of individuals. On the contrary, one of the conclusions emerging from these streams is that individual mindfulness is central for agility. But because research is framed around technologies and development methods, the results are discussed primarily within these more focused contexts.

Hence, current research leaves room for empirical research that more directly focuses on the characteristics of individuals, organisational processes and structures that enable agility. Early conceptual papers addressing the role of the IS organization and IS personnel provide a starting point for such research. Research on the actual practices associated with agility, in line with similar research with respect to IS strategizing (Peppard et al., 2014) and alignment (Karpovsky and Galliers, 2015) might also be considered.

Furthermore, if we accept the view that agility is itself a synergistic concept (i.e., that agility in one IS task is of limited value if other tasks are not agile), then also a more holistic research approach or theory might be useful. A call for a more holistic theory is hardly a surprise in any research field. Holistic theories are inevitably at a higher level of abstraction, thus making them more difficult to validate empirically and to communicate to practitioners. Having said that, a more unified theory of IS agility could be based on the simple observation that in all research streams, agility appears to be related to choices in, for example, technology, practices/methods, personnel competences and organisation structures. Such a theory would not replace, but rather contextualise, clarify and add value to the research carried out in different sub-streams.

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