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Agility in organizations: A bibliographic investigation into the state of the art*

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〈Abstract〉

Research on agility, which started to become popular in the 1990's, has over the years coalesced into multiple distinct streams with often little cross-fertilization. This has made it difficult to consolidate what has been learned about agility across the separate streams of research. Although qualitative literature reviews have been produced, due to the large number of articles these reviews can only capture a limited slice of the literature. In contrast, this article carries out a systematic literature review on agility in organizations using a bibliographic coupling and content analysis. We find three main clusters of research around agility: (1) software development agility, (2) supply chain management agility, and (3) strategic IT agility. Our findings show that information technology is a major contributor to agility research, and suggest shared perspectives on agility that combine ideas from these clusters as avenues for future research. Such shared perspectives can advance agility research, and more importantly, may offer pathways for theorizing in specific, emerging areas of management.

Keywords : agility, literature review, bibliographic coupling

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Ⅰ. Introduction

Faced with rapidly changing circumstances such as increased competition (Goldman & Nagel, 1993; Goldman et al., 1995; Sanchez & Mahoney, 1996; Volberda, 1996), e-business (Breu et al., 2002; Overby et al., 2006; Sambamurthy et al., 2003), and digital transformation (Salmela et al., 2022), managers have become cognizant of the importance of agility to successfully navigate such challenges. Although there are many different definitions (See Salmela et al. 2022 for a relatively recent overview), the concept may be described as "the capacity of an organization to efficiently and effectively redeploy/redirect its resources to value creating and value protecting (and capturing) higher-yield activities as internal and external circumstances warrant" (Teece et al., 2016, p. 17). Agility is needed in an environment that has a great deal of uncertainty, making managerial capabilities insufficient for all contingencies and risks. In such environments, agility should be built within the organization for example by introducing redundancy or slack resources, but because of the costs involved, agility should be promoted only in highly uncertain environments.

During the last two decades a tremendous amount of research on agility has resulted in an accumulation of vast and diverse body of knowledge focusing on different organizational contexts, levels of analysis and theoretical perspectives. Agility has received attention in various research fields ranging from manufacturing and management to information systems and software development. This extensive body of research has generated useful insights on agility, but it also suggests increasing fragmentation of research with little cross-fertilization of ideas. At present, we do not have a clear picture of how research on agility converges or diverges across different but closely related domains, underscoring the need for a comprehensive mapping of fragmented agility research. At present it is imperative to systematically map and synthesize the fragmented landscape of agility research to facilitate a comprehensive understanding of its evolution and implications.

Although there have been some literature reviews on agility, they are constrained to specific topical areas, such as manufacturing (Potdar et al., 2017), supply chain agility (Sharma et al., 2017), workforce agility (Salmen & Festing, 2022), marketing agility (Kalaignanam et al., 2021), and software engineering (Shahbaz et al., 2018a; 2018b). A multifaceted and interdisciplinary view of the concept of agility can create insights and principles that could be applied in a number of organizational areas, avoiding duplication of research efforts. However, such efforts are stymied at the moment due to the sheer number of application areas for agility and the difficulties to consolidate findings across this vast research field.

To the best of our knowledge this is the first study to report and discuss the results of a comprehensive body of agility related literature spanning different areas of research. In contrast to previous qualitative reviews, this study adopts a comprehensive view, covering the concept of agility

in different domains, and employs bibliographic coupling-based content analysis to analyze agility literature published between 1997 and 2020. A bibliometrics approach is more systematic and transparent, and hence minimizes researcher's bias which is known to influence qualitative reviews. As our objective is to explore the scope of agility-related research and detect current research priorities, we deployed the method of bibliographic coupling, which focuses on current trends rather than past traditions.

The results illustrate an emerging intellectual structure of agility research in organizations, focusing on three clusters: (1) software development agility, (2) supply chain agility, and (3) strategic IT (information technology) agility. These clusters investigate either software development firms on the one hand (cluster 1), and organizations in general (clusters 2 and 3), on the other hand. Overall, these three clusters represent loosely interconnected but distinct subfields of inquiry related to agility. In this paper, we will describe each cluster in terms of typical agility definitions, theoretical framework and major findings.

We additionally identify promising paths for future research building on cross-fertilization of ideas from the three distinct clusters which can contribute to develop a more comprehensive and integrated body of knowledge around agility. Related to this, we suggest that future scholarly attention should be directed towards digital firms, where development of digital value offerings constitute both a traditional resource and a widely addressed target for agile software development research. In general, we consider digital transformation in many traditional industries leading to increasingly uncertain and unfolding market environments, adding pressures for agility in carrying out operative or development tasks.

The following sections expand on the research design, along with the literature sample and analysis method (section 2), results and findings in the literature clusters and subclusters identified (section 3), discussion about the findings (section 4), paths for future research (section 5), lessons learned for businesses (section 6), and the conclusion (section 7).

Ⅱ. Research design

Over the years research on agility in organizational context has grown exponentially. Given the breadth of research on agility published in different journals and scientific fields, a vast body of research is available for synthesis. Therefore, we used bibliographic coupling, a bibliometric analysis, to objectively and comprehensively cover different strands of research on agility, identify major findings therein and propose future potential research directions.

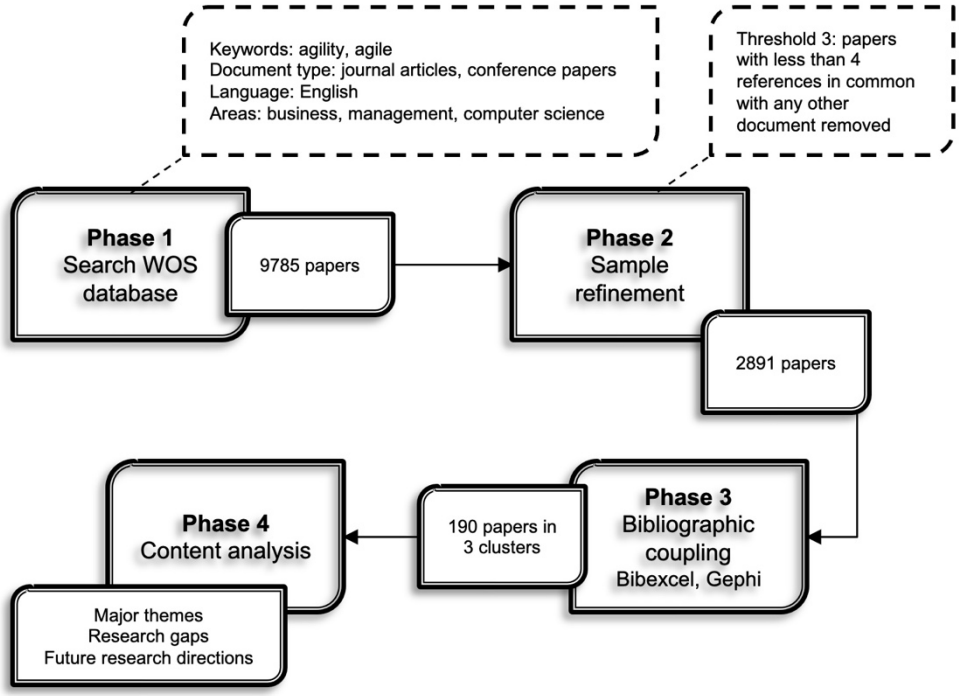
Bibliometric analysis refers to “the set of quantitative methods used for analyzing academic literature” (Belussi et al. 2019, p.2). Bibliometric analysis is a quantitatively driven analysis procedure with the capability to analyze vast number of academic records. Therefore, it contrasts to narrative literature review, which suffers from subjectivity, incomprehensibility and lack of reproductivity (Mariani & Borghi, 2019).

The first step in bibliometric analysis is the identification of papers representing the theme under investigation. In the second step, a suitable bibliometric technique is used to analyze the papers to map and identify subfields or streams of research in the field. This is then followed by qualitative analysis of the papers in each stream of research.

2.1 Data/sample

A comprehensive bibliometric analysis requires collection of all those papers which are relevant to the theme under investigation (Zupic & Cater, 2015). In this study data were retrieved from Social Science Citation Index Web of Science database, which is an authoritative, well recognized, and commonly used source of bibliometric data (Zupic & Cater, 2015). Initially all documents which contained the terms ‘agility’ or ‘agile’ in the title, abstract or author keywords were selected. We limited our search to the fields, business, management and computer science. Moreover, search was limited to journal articles and conference papers published in English language only. Indeed, there is a possibility that the two terms are used in a general sense without any connection to agility research. However, such documents will not have any clear links to mainstream literature on agility and consequently few common citations. Therefore, in bibliometric terms, they will be excluded automatically with the application of threshold on the later stages of the analysis (Vogel & Güttel, 2013).

The two search terms resulted in an initial dataset of 9785 documents including conference papers and journal articles published in the English language. To reduce the sample to only the relevant papers, all those papers which did not have more than 3 references in common with any other document were deleted. This resulted in a final sample size of 2891 documents. The search was limited to the documents published in business and management, and engineering fields. An overview of the analytical process is provided in Figure 1.



〈Fig. 1〉 The sampling procedure

2.2 Method

Given our aim to map out current research on agility in organizations and to identify main findings, bibliographic coupling, a bibliometric method, was used for data analysis. Bibliographic coupling was introduced by Kessler (1963). In recent years use of the bibliographic coupling method has become more widespread in social science research as it has been found to be effective for topic clustering, particularly in capturing current and emerging research on a topic of interest (Boyack & Klavans, 2020).

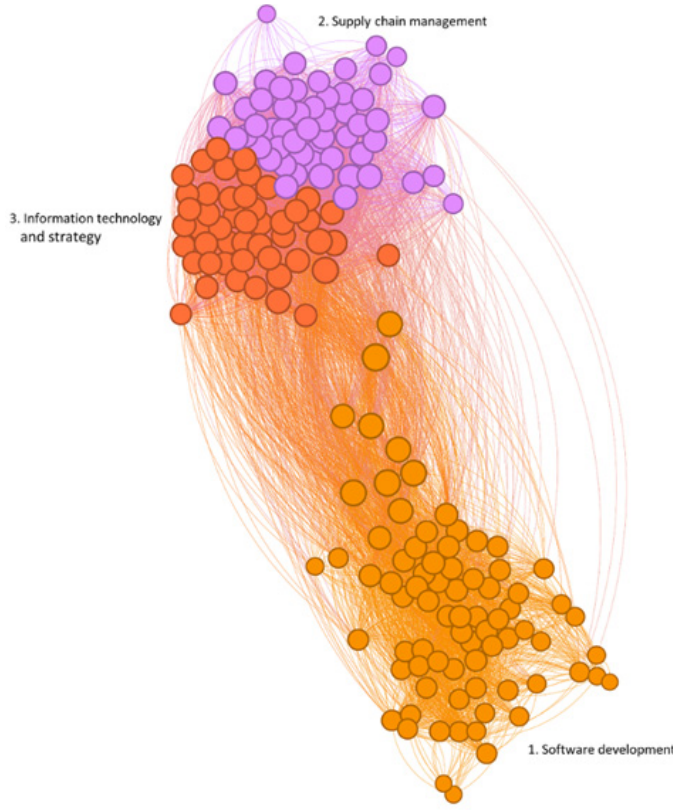
Based on the assumption that papers citing common references are likely to cover similar research topics, bibliographic coupling measures similarity between two documents based on the overlap in their list of references (Agostini & Nosella, 2019). The higher the coupling strength, the greater are the chances of topical similarity between two documents (Zupic & Cater, 2015). Suitability of the bibliographic coupling for exploring current and emerging research emanates from the very fact that analysis in this method focuses on citing documents which are always more recent than cited documents and also because shared references between two documents stay constant over time (Boyack and Klavans 2010; Mura et al., 2018). Therefore, it is a particularly suitable method for exploring current and emerging streams of research on agility.

2.3 Data analysis

Bibliographic coupling analysis starts with the construction of a similarity matrix which displays number of shared references for each pair of documents (Mariani & Borghi, 2019). To produce the similarity matrix, we imported the citation data of initially collected documents into BibExcel, a commonly used bibliometric analysis tool for data processing (Persson et al. 2009). The initial similarity matrix contained all documents from the sample in first rows and columns, and the number of shared references in cells (Agostini & Nosella, 2019).

In the next step, to identify research clusters or subfields in agility research, network analysis was used to process the similarity matrix (Mariani & Borghi, 2019). Network analysis approach is preferred over more traditional multidimensional scaling approaches as it is considered to be more effective in finding clusters of research in a field (Zupic & Cater, 2015) and hence adopted increasingly in bibliometric studies (e.g., Agostini & Nosella, 2019; Mariani & Borghi, 2019; Mura et al., 2018). We used the Gephi network analysis software (Bastian et al., 2009) and applied the Louvain community detection algorithm (Blondel et al. 2008) to produce partition or clusters of networks. This algorithm builds on the notion of modularity. It assigns each node in a network to a community and iterates through all communities while checking whether reassigning nodes to adjacent communities increases modularity, and selecting changes which result in maximum modularity (Blondel et al., 2008). This process continues until the most optimal network structure is determined.

The Louvain algorithm assigns a community to each node. Therefore, it is important to filter important papers beforehand (Zupic & Cater, 2015). As is common in bibliometric studies (e.g., Mariani & Borghi, 2019; Mura et al., 2018, Vogel & Guttel, 2012), we used a thresholding approach to select only the most relevant papers. After trying different thresholds, we finally selected 14, with two as the final threshold, meaning that only those papers that had at least two common references with at least 14 other papers were retained. This threshold resulted in a set of 190 documents representing closely connected documents.



〈Fig. 2〉 The identified clusters with included articles

The final structure of the network (Figure 2) comprised of 190 nodes, 8007 edges, and have average degree of 81 and modularity of 0.40. Overall, three major clusters are identified which are differentiated with colors, the nodes represent documents, and the edges are links between documents based on their shared references.

Ⅲ. Results/findings

A content analysis of the three clusters was conducted to understand the predominant research topics in each cluster. The composition and main topics of each cluster are discussed below.

3.1 Software development

Cluster one focuses on the area of software development. Agility in this cluster is conceptualized

around the so-called Agile Methods, covering certain phases in software development (Abrahamsson et al., 2010). Some papers in this cluster refer to the dictionary definition of agility, denoting agility as "the quality of being agile; readiness for motion; nimbleness, activity, dexterity in motion" (see, for example, Abrahamsson et al., 2003; Abrahamson et al., 2010). One of the widely used definitions for Agile Methods is provided by Conboy (2009), who characterizes agile methods as providing "continual readiness 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." Overall, agile is seen as an umbrella term for similar IS development methods, and many papers list the names of typical Agile Methods, such as Scrum, RAD, XP, DevOps or SAFe. These methods are seen as facilitating software development based on the centrality of individuals and interaction, incremental delivery of working software, collaboration with customers and response to change (Hoda, R; Kruchten, P; Noble, J; Marshall, S, 2010; Batra, D; VanderMeer, D; Dutta, K, 2011; Ghezzi and Cavallo, 2020).

The trigger, creating a need to deploy agile methods, is typically associated to the emerging and unfolding nature of user requirements, creating pressures to allow changes in these requirements throughout all stages of the software development project (Conboy, 2009; Batra et al., 2016). In this regard, the traditional ISD methods relying on systems development life cycle with separate phases were deemed as insufficient. Many software firms adopted Agile Methods at the time when development of the Internet and web-based applications started replacing prior complex and large transaction processing systems projects (Lyytinen & Rose, 2006; MacCormack et al., 2001). The trend towards Agile Methods has been further accelerated by transition towards the provision of software as a service (Paasivaara et al., 2014). Agile Methods appear to provide a structure within which users and developers can learn about user requirements as well as opportunities and design options provided by digital technologies on a continuous basis. Subsequent research in software engineering, computer science, and information systems disciplines has then addressed multiple parallel sub-clusters in this cluster: (1) organizational adoption of Agile Methods, (2) Behaviour in agile teams, and (3) leading and controlling multiple agile teams, which will be described next.

The purpose in the first sub-cluster, organizational adoption, is to understand motivating factors, facilitators and inhibitors for organizations to adopt agile methods (Cram and Newell, 2016; Batra, 2020). Some studies have compared adoption rates geographically, for example between developed and developing countries (Batra et al., 2016; Shahbaz et al. 2018a; 2018b), or according to the nature of systems being developed, for example in data warehousing and business intelligence development projects (Batra, 2017; 2018). The adoption of Agile Methods does not always lead organizations to fully abandoning traditional methods. These methods may also co-exist (van Waardenburg, G; van Vliet, H, 2013) and some organizations can also seek to combine these two methods to promote

simultaneous exploitation and exploration of knowledge (Cram and Marabelli, 2018). Hence, studies in this sub-cluster often examine how organizations with limited agile experience navigate the transition from a traditional ISD approach to a hybrid, agile-traditional approach (Cram, 2019). Selecting the first pilot project relying on agile methods is a delicate task that should be done carefully (Gandomani et al., 2013), and similar selection criteria can be usefully deployed also later (Khan et al., 2014). Frameworks have been proposed for the transition process (Gandomani and Nafchi, 2015), together with studies highlighting the importance of adequate training for successful transition (Gandomani et al., 2015). Senior management support is a critical enabler of successful organizational adoption (Doraira et al. 2013; Hoda et al., 2011). For large organizations with multiple global sites, transition to Agile Methods is a long journey, with several consecutive phases, challenges and mitigations (Paasivaara et al., 2013; Paasivaara et al., 2014). In small firms or digital start-ups, agile software development methods are often the first methods to be used, and their use is closely bundled with Business Model Innovation (BMI), leading to Lean Startup Approaches that can support Strategic Agility in Digital Start-ups (Gonzalez-Cruz et al., 2020; Ghezzi and Cavallo, 2020).

The sub-cluster on behaviour in agile teams focuses on describing and explaining dynamics in agile teams: how do agile teams, and members within those teams, learn to use the new methods. In this regard, group maturity plays an important role: adopting agile principles and practices appears to be easier for mature teams with long experience in working together (Gren et al., 2015; Gren et al., 2017; Gren et al., 2020). Teams have also been found to adapt methods, and apply principles, practices and roles as needed to best support their freedom for self-organization and specific requirements of the project (Hoda et al., 2010a; 2010b; Hoda et al., 2012; Hoda et al., 2013; Bass, 2014; Batra et al., 2017). Because teams rely on informal interaction and knowledge sharing (Dorairaj et al., 2012), the learning process can also lead to learning failure, as team members desire for cohesion within the team (McAvoy and Butler, 2007, 2009a; 2009b). Studies have also focused on specific practices, such as pair programming, examining the efficacy and performance of programming pairs, or paired designers, in responding to user requests (Balijepally et al., 2009; Mangalaraj et al., 2014; Kude et al., 2019). Agile practices have also been associated to yielding benefits and higher satisfaction for software developers (Bonner et al., 2016). Particular attention has also been placed on geographically distributed and culturally diverse teams, placing additional demands for team interaction and knowledge sharing (Dorairaj et al., 2012; Dorairaj and Noble, 2013; Alzoubi and Gill, 2020).

The sub-cluster on leading and controlling multiple agile teams addresses tensions and dependencies between multiple agile teams and their broader organizational and technological context (Strode, DE, 2013; 2016). Initially, agile methods did not offer adequate support for project management (Abrahamsson et al., 2003; McAvoy and Butler, 2009). Agile principles and practices have later been

extended to link self-organizing agile teams with project management and organizational coordination activities (Batra et al., 2011; Hoda and Murugesan, 2016; Paasivaara and Lassenius, 2016; Recker et al., 2017; Bass, 2016). Senior management support, agile strategy and supportive culture have been found to be necessary facilitators for human resource management, financial sponsorship, infrastructure and technology, and customer liaison (Dorairaj et al., 2013; Strode et al., 2012). One specific area receiving attention is related to the fact that agile teams do not necessarily formally document their design decisions (for example decisions on data structures, application modules and interfaces), thus jeopardizing the overall IT architecture. Tools to condensate knowledge from unstructured textual electronic means are designed to collect architectural knowledge from design discussions (Borrego et al., 2016; Borrego, 2016; Borrego et al., 2017; 2017b, Borrego et al., 2019; Alzoubi et al., 2020). Involving customers to the agile teams have been found to be critical (Hoda et al., 2011). To improve this vital interaction, establishing product owner roles, identifying functions related to these roles, and establishing product owner teams, have been proposed (Bass, 2013; 2015). Methods have also been proposed to improve cost estimation (Sadiq and Hassan, 2014) and release planning (Szoke, 2010; Paasivaara et al., 2014; Szoke, 2009), thus facilitating timeliness, but also visibility and predictability outside the immediate agile development team.

3.2 Supply chain management

Cluster two explores agility in the context of supply chain management. Discussion in this cluster revolves around supply chain agility, which refers to "the result of integrating a supply chain's alertness to changes (opportunities/challenges) – both internal and environmental – with the supply chain's capability to use resources in responding (proactively/reactively) to such changes, all in a timely and flexible manner" (Li et al., 2008). This definition is among the most frequently cited in the cluster. Along with supply chain agility, other related concepts, such as supply chain flexibility (e.g. Fayezi et al., 2015) and supply chain resilience (Li et al., 2017; Abeysekara et al., 2019), are also used. Many of these alternate notions of agility are already addressed in the paper by Li et al. (2008).

Hence, the theoretical foundation of the concept of supply chain agility is primarily built on the concept of agility, as many definitions contain references to sensing and responding to environmental events, such as opportunities, threats, and generally just change. It is also often emphasized that sensing and responding must be speedy; and occasionally, the particular organizational functions or areas critical to supply chain agility are specified. A number of papers explicitly define supply chain agility in terms of dynamic capabilities (e.g. L'Hermitte et al., 2015; Aslam et al., 2018) or the resource-based view of strategy (e.g. Gligor & Holcomb, 2014; Dubey et al., 2018), which is one of the conventions in agility research. However, this appears to be more an exception than the norm.

The trigger creating the need for agility in supply chains is not always very explicit. After all,

changes in global supply changes are somewhat typical, and the ability to proactively or reactively deal with such changes has operative value for all organizations, together with adaptability and alignment. In some themes, however, research focuses also on specific contexts with a large amount of uncertainty, such as supply chains in developing countries, or humanitarian supply chains.

Although in terms of the concept of agility this cluster focuses on supply chain agility, the broad area of interest in the cluster is more accurately the supply chain itself, and its contribution to the organization as a whole. This is reflected in an interest in dependent variables such as firm performance (Gligor & Holcomb, 2012), financial performance (Gligor et al., 2015), and competitive advantage (Li et al., 2008), in addition to simply supply chain agility (Gligor, 2014). It could be said that, by and large, supply chain agility is seen to be not just an object of interest for its own sake, but more importantly a factor that can improve organizational outcomes. Hence, the papers in this cluster explore other supply chain topics indirectly linked to agility: supply chain ambidexterity (Aslam et al., 2018), triple-A/best-value supply chains (e.g. Li et al., 2015), and humanitarian supply chains (e.g. L'Hermitte et al. 2015).

In this cluster there are three main sub-themes or topics of research. The first one is about the development and core effects of supply chain agility in organizations. The second theme focuses on the triple-A supply chain in which agility is discussed along with adaptability and alignment aspects of a supply chain. The third theme discusses issues of agility in humanitarian supply chains.

In the sub-cluster of supply chain agility development and implications several studies focus on identifying factors which lead to the development of agility. These factors can be roughly categorized into three groups. The first group consists of those variables that are related to technology and its use, e.g. "technology" (as such), Big Data Analytics personnel expertise capabilities (Mandal, 2018), and supply chain business intelligence competence (Sangari & Razmi, 2015). They reflect the importance of technology and data for the effective and sustainable operation of the supply chain. The second group consists of variables that relate to supply chain management or value chain management, such as supply/demand management (Gligor, 2014), logistics capabilities (Gligor & Holcomb, 2014), and variety management strategy (Um, 2017). These variables underline the simple fact that supply chain agility requires a high-level skill to manage the supply chain and individual activities within it. The third group consists of more generalized organizational factors such as external knowledge sharing (Tuan, 2016), organizational ambidexterity (Tuan, 2016), and competitive intelligence (Tuan, 2016), which emphasize that certain activities and competences must exist throughout the organization to enable supply chain agility.

The sub-cluster of triple-A supply chains is an incipient area of research that has formed around the notion of triple-A, or best-value, supply chains that exhibit three distinct characteristics: agility, adaptability, and alignment (Li et al., 2015). Therefore, triple-A supply chains go beyond supply

chain agility in that additional requirements are imposed for supply chains. Papers in this subcluster focus on investigating antecedents and outcomes for triple-A supply chains and propose a measurement model for such supply chains. It should be noted that there is a connection between this subcluster and the humanitarian supply chains subcluster, as the triple-A supply chains are found to be helpful to humanitarian supply chains (L'Hermitte et al. 2015; Dubey & Gunasekaran, 2016).

The agility of the humanitarian supply chain is an emerging area of research that addresses the special circumstances inherent in humanitarian operations and investigates what requirements these circumstances pose to the involved organizations in terms of agility. L'Hermitte et al. (2015), the earliest publication in this subcluster, note that prior research has only sporadically discussed agility as a requirement for humanitarian supply chains, and that a more comprehensive approach is needed. In subsequent publications, L'Hermitte et al. outline four strategic dimensions of agility for humanitarian supply chains (2016a) and find that agility is also a requirement for longer-term humanitarian operations that last beyond the acute phase of a crisis (2016b). Other researchers in this subcluster establish connections to literature areas outside of the subcluster.

3.3 Information technology and strategy

Articles in the third cluster of research are from information systems and management fields. In this cluster most of the papers are about the role of IT in the development of organizational agility. Perhaps the most widely cited definition for agility in this cluster is provided by Sambamurthy et al. (2003, p. 238) who define agility as "the ability to detect and seize market opportunities with speed and surprise".

The trigger creating the need for agility in this cluster is linked to hypercompetitive markets, with intense rivalry and time-to-market pressure. Agility is needed, for example, in capitalizing digital options created by IT (Sambamurthy et al., 2003). An underlying theme in the cluster is how IT can promote (rather than prevent) organizational agility.

A common aspect amongst studies in this cluster is that the impact of IT on agility is studied at macro or organizational levels. Some of the most studied agilities in this stream are market capitalizing agility (Lu & Ramamurthy, 2011; Mikalef & Pateli, 2017), operational agility (Beck et al., 2016; Queiroz et al., 2018), process agility (Chen et al., 2014) and strategic agility (Lee et al., 2016). There are no studies on the team or network level agility with the exception of Liu et al. (2013) which focuses on supply chain agility, but is nevertheless affiliated with this cluster.

Four emerging sub-clusters in this cluster are about the impact of IT capability, IT ambidexterity, IT alignment, and business intelligence systems. Resource-based and dynamic capability views provide the theoretical foundation to most of the studies in this stream.

The major topic in the sub-cluster of IT capability is on the impact of IT capability on agility. The

basic premise is that IT capability, which is defined mostly in terms of firms' investment on IT (Ravichandran, 2018), management orientation to IT (Beck et al., 2016; Lu & Ramamurthy, 2011), prevalence of IT infrastructure (Liu et al., 2013; Roberts & Grover, 2012a; 2012b) and managers' IT competency (Panda & Rath, 2017; Tallon, 2008), is a major driver of organizational agility. The information processing view is dominant in these studies. IT as an information processing tool and inter-functional coordination platform helps to sense and adapt to internal and external changes and consequently makes organizations agile. There are a couple of articles in this group which study the role of environmental factors in this relationship. Environmental dynamism (Beck et al., 2016) and complexity (Chen et al., 2014) strengthen the relationship between IT capability and organizational agility. Nevertheless, environmental hostility is found to weaken the effect of IT on agility as uncontrolled hostile environmental forces may not allow an organization to capitalize on its IT capability to respond to market demands.

A second group of studies addresses the relationship between IT alignment and agility. Most of the articles in this group find that harmony in IT processes and business operations enhances organization capacity to quickly seize emerging opportunities and hence contribute to the development of an agile organization (Liang et al., 2017; Panda & Rath, 2018; Tallon & Pinsonneault, 2011; Zhou et al., 2018). Nevertheless, there are some caveats to this relationship. A positive impact of IT alignment on agility is contingent upon IT flexibility, its scalability and adaptability (Tallon & Pinsonneault, 2011). IT social alignment, which refers to informal IT-business-human relationships, enhances agility. But intellectual/structural alignment, which refers to existence of interrelated business and IT strategies, actually reduces agility (Liang et al., 2017). Nevertheless, this is contradicted by Zhou et al. (2018) as both social and intellectual agility was found to enhance agility particularly if there is a balance between the two.

A third sub-cluster of articles analyses the impact of IT ambidexterity, the simultaneous pursuit of exploration and exploitation of IT resources, on organizational agility. A continuous adjustment in IT policies and practices make it easier for an organization to respond to internal and external changes. Overall, studies in this group while using quantitative techniques provide strong evidence that IT ambidexterity -driven management of both current and emerging technologies, and their novel applications, enhance an organization's potential of becoming an agile organization (Queiroz et al., 2018; Lee et al., 2015; Mao & Quan, 2015; Syed et al., 2020).

Within the scope of the IT-agility perspective, the role of business intelligence systems is also addressed by a small number of papers (Corte-Real, Oliveira & Ruivo, 2017; Knabke & Olbrich, 2018; Park, El Sawy & Fiss, 2017). These papers are quite recent and focus mostly on BI systems laden with modern technologies such as big data analytics, artificial intelligence and data mining. All three papers found that in fast unpredictable environments organizations with working modern BI systems

are usually more agile in their operations and decision making.

In addition to studying IT as antecedent of agility, some studies in this stream also investigate implications of organizational agility. Overall, some of the outcomes of organizational agility identified in this stream of research include firm performance (Queiroz et al., 2018), innovation (Tsou & Cheng, 2018) and product development speed (Syed, Blome & Papadopoulos, 2020).

Ⅳ. Discussion

Based on our bibliometric study, agility is currently investigated mainly in three organizational contexts. In cluster 1, the main attention is on tasks related to software development that occur in software firms and information system development units of companies in other industries. In cluster 2, the focus is on operations related to collaboration within supply chains. Cluster 3 focuses on the capitalization of information technology, IT infrastructure and information system services for achieving organizational strategic goals ensuring IT-business strategy alignment. In short, scholars in recent times have been mainly interested to investigate agility with respect to information technology, software development and IT-strategy alignment, and supply chain management.

In the following discussion we present a comprehensive summarization of themes apparent in three clusters. We explore the links in terms of defining the (1) need for agility, (2) ways in building agility, and (3) understanding the implications and benefits of agility, as shown in Table 1, for readers' convenience, and elucidated further in the subsections below. These themes are derived from our definition of agility given in the introduction (Teece et al., 2016, p. 17):

1. Need for agility: *"…as internal and external circumstances warrant…"*
2. Ways of building agility: *"the capacity of an organization to… redeploy/redirect its resources to… activities"*
3. Understanding the implications and benefits of agility: *"efficiently and effectively…value creating and value protecting (and capturing)… higher-yield…"*

〈Table 1〉 Summary table of cluster structure

		Cluster 1: Software development	Cluster 2: Supply chain management	Cluster 3: Information technology and strategy
Need for agility		Unfolding nature of user requirements	Unexpected incidents or changes in the supply chain	Hypercompetitive markets
Ways in building agility	Managerial behaviours	Directly leading the agile teams and developing organizational structures	Coordination of supply/demand management and logistics capabilities	Developing technology-based processes and structures and coordinating the development of IT infrastructure
	Employees and teams	Interaction and dynamics within software development teams and capabilities of individual team members	Skills of employees and IT professionals	Professional skills of organizational members
	Structures and cultures	Specific methods and tools that promote frequent and rich communication and a completely different organizational culture	Information systems enabling analysis of data	IT infrastructure development and its alignment with organizational strategy
Implications and benefits of agility		Project efficiency and success	Supply chain efficiency, firm performance, financial performance, and competitive performance	Firm performance and competitive performance

However, even though we summarize an overall picture of agility research emerging from our review, we would like to emphasize that this view is not intended as a new model or a framework of agility. It is intended as a guiding vehicle for future research that can help researchers find similarities and differences between clusters to be further explored. Our research re-iterates that agility depends on context and we believe our findings should be understood with that in mind.

4.1 Need for agility

The need for agility in all three clusters is related to specific environmental conditions that are seen as requiring agility. The environment is changing in an unexpected or unfolding manner, restricting the timeframe for an organization to respond. Definitions of agility in all clusters often include words such as rapidly or nimbly, to highlight the constrained timeframe for sensing and responding. However, the reason why constrained timeframes exist varies in each research cluster – this can be seen to relate to the salient sources of risk for given environmental conditions. In cluster 1, focusing primarily on software development, the need for agility is related to the unfolding nature of user requirements, making it difficult to fix systems requirements at any given point of time. In cluster 2 about supply chains, agility relates to unexpected incidents or changes in the supply chain,

requiring a quick response, including the areas of procurement/sourcing, manufacturing, and distribution/logistics (Swafford et al., 2006). In cluster 3, where management and the strategic use of IT are major themes, the need is related to hypercompetitive markets, where success is dependent on the ability of the firm to capitalize on options faster than competitors. Therefore, the concept of agility highlights these specific sources of risk in each cluster that create the constrained timeframe underlining the capability to respond as quickly as possible. The assumption is that addressing those risk sources will improve an organization's performance and chances of success.

4.2 Ways of building agility

Building agility is seen as requiring specific *managerial* behaviours, behaviours of employees and teams, but also somewhat malleable organizational *structures* and culture that enable or encourage, rather than prevent, rapid or nimble behaviour. We distinguish between managerial behaviors and employee behaviors that are triggered by external conditions that create a constrained timeframe for capitalizing on opportunities and meeting threats. Managerial behavior refers to organization-level decisions and actions. Employee behavior refers to operative-level work, taking place, for example, in operational or development teams. As a third component, we identify structures that promote (or inhibit) the behavior of managers and employees who also possess the ability to change those structures. Structures generally refer to more stable attributes of the organization, such as organization and technology structures, product structures, formal methods, and process prescriptions, or even culture and identity.

The role of *managers* is evident in each of the three clusters. Managers have an important role: they coordinate and orchestrate the two other aspects of agility – employees and structures. The emphasis is, however, slightly different in each cluster. In software development, the role of managers is seen as critical in directly leading the agile teams (Mcavoy et al., 2009) but also developing organizational structures; they initiate and manage the process for organizational adoption of agile methods to complement or replace the traditional planning oriented and structured methods (Szoke, 2009). In large software firms with many concurrent projects, managers are also central in creating additional structures (Bass, 2016), and scaling agile to coordinate across multiple software development teams (Bass, 2014). In the area of supply chains, the notion of supply chain management comprises managerial tasks such as coordination of supply/demand management (Gligor, 2014) and logistics capabilities (Gligor & Holcomb, 2014). Such coordination expands organizational boundaries and is perhaps supported with a variety management strategy (Um, 2017). In the area of organizational IT units, the role of managers is more geared toward developing technology-based processes and structures: they are seen as central in coordinating the development of IT infrastructure and services in a manner that promotes, rather than prohibits, various forms of

organizational agility to achieve organizational goals.

The three clusters also recognize the significance of *employees* and teams for agility in sensing and responding within the context of organizational structures. Managerial-level actions are not enough to account for complex situational factors, and this necessitates the empowerment of operative personnel in all the areas of software development, organizational IT units and supply chain management. In Cluster 1, much research focuses on interaction and dynamics within software development teams (Gren et al., 2020), and the capabilities of individual team members that are required to take advantage of the freedom that agile methods offer (Borrego et al., 2019), but also in refining those methods while using them (Hoda et al., 2010). In studies addressing IT and business alignment, the skills of employees and IT professionals is considered as important for designing flexible structures that promote agility in other business units (Panda & Rath, 2017). Similar attention to professional skills is given in supply chain management, although it applies more broadly to organizational members, not only to the IT-unit employees (Mandal, 2018; Tuan, 2016).

While appropriate behavior of managers, individuals, and teams are required in sensing and responding, all three clusters pay attention to permanent structures and culture but with varying degrees. Structures and culture are important, as they directly promote and encourage managers and teams with information and knowledge sharing, necessary for rapid sensing and responding with new situations. But it is equally critical that structures are malleable, that they can be adjusted as needed, rather than being fixed. In software development, the agile manifesto identifies many principles aiming not only on specific methods and tools that promote frequent and rich communication (González-Cruz et al., 2020), but also a completely different organizational culture where even the methods themselves are only a means and can be adapted (Hoda et al., 2010). In supply chain management, a particular emphasis is paid on information systems (Shashi et al., 2020), enabling analysis of data, to make sense of situations and to spot opportunities, which becomes an important antecedent for agility in managing supply chains. Likewise, research on organizational IT capabilities has explored IT infrastructure development and its alignment with organizational strategy, that make the IT infrastructure itself a flexible structure, and allowing fast reconfiguration of it, as needed in new situations (Zhou et al., 2018).

Each of the three requirements for building agility; managerial and employee behaviors and organizational structures, can be found in the literature on dynamic capabilities. They are inscribed in routines, competences and intangible organizational resources that sustain corporate dynamic capabilities. From this perspective agility is compatible with dynamic capability. Where agility can offer further insights is perhaps in the specific contexts and the realities of organizational life where it has uncovered its recommendations. It is important to understand that the need for agility, and consequently the areas of organizational life which should evolve to deal with relevant sources of

risk, may depend on particular contexts.

4.3 Implications and benefits of agility

Though a marginal topic, **implications and benefits of agility** have been explored in all three clusters. In the first cluster related to software development, implementation of agile principles is found to enhance project efficiency (Recker et al., 2017) and success (Hummel & Epp, 2015). In the second cluster which is about supply chain, supply chain efficiency (Dubey and Gunasekaran, 2016), firm performance (Gligor & Holcomb, 2012), financial performance (Gligor et al., 2015) and competitive performance (Li et al., 2015) are amongst the common supply chain agility implications. In the third cluster on IT and strategy, agility implications have been studied in the context of firm performance (Chen et al., 2014) and competitive performance (Mikalef & Pateli, 2017). These variables are largely germane to the dynamic capabilities literature.

We believe that the summary of agility research clusters in this section is useful since it helps in seeing both divergent and convergent ideas in the three clusters. For example, clusters two and three seem complementary in terms of implications and benefits of agility, and the employees and teams aspect of ways in building agility. Researchers could try to seek common ground in these areas. On the other hand, divergence can be seen in most aspects of cluster one compared to the other two clusters. The need for agility is also different in each of the three clusters, showing that each cluster originates from different background assumptions. In the following, we apply our learning from this review to the state of the art in management research, and propose ways forward for agility scholars.

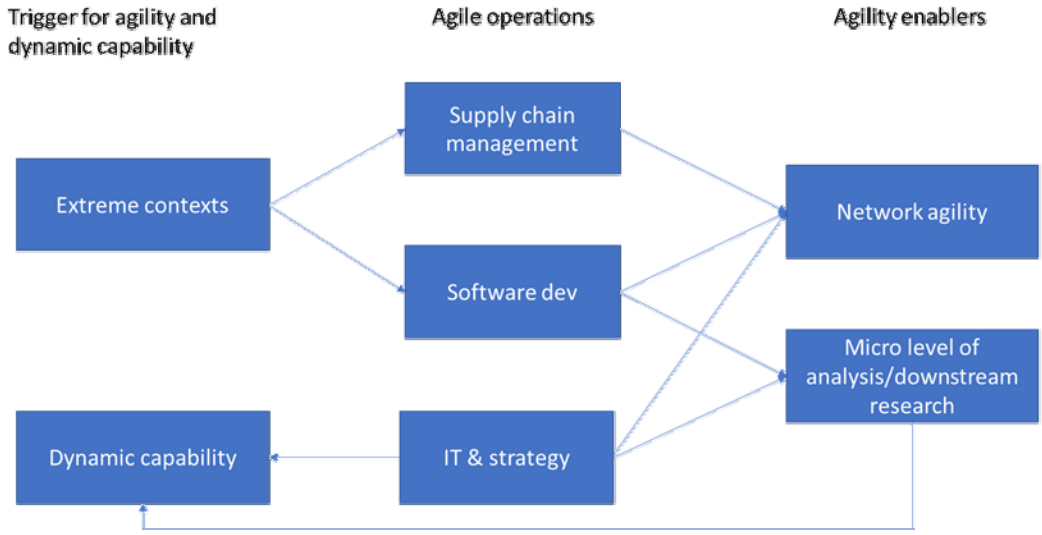
V. Paths for future research

The analysis and discussion of the three clusters allow the identification of interesting gaps which we suggest should be explored in future research on agility.

In specific contexts, as discussed above, there is the possibility to learn from agile methods developed somewhere else. But a further question for future research is whether it is possible to develop standardized practices concerning different enablers of agility which are universally applicable regardless of context. While standards are usually perceived as antithesis of agility but would it still be considered so if built in provisions in practices lend themselves to be used in a tailored way to achieve agility. We are not expecting enablers to be easily transferred from one area (cluster) to another — agile methods form an important structure in software development, but as such, they may be less useful in technology-strategy alignment. They do, however, raise the question of methods (as structures) more broadly: can methods play a role in enabling agility? Do such

methods exist and if they do, what are their key characteristics? By doing so, a generic framework may reduce the risk for incomplete framing of the problem, and the proposal of partial solutions in studies addressing agility in any specific field.

We feel that future research should not only focus on defining the enablers for agility, which there is plenty of appetite for, but also to attempt to define the triggers for agility (Figure 3). It should be recognized that agility sometimes is taken to mean flexibility in routine situations whereas at other times, it means flexibility in special, out of the ordinary, situations. These situations are inherently very different, and therefore may require radically different solutions. Hence, this divergence in discussing agility tends to cause conflicting results in the literature when slack resources are presented as an enabler for agility in volatile contexts or when optimization of certain processes is presented as an agility enabler in routine contexts. Both of these enablers may be acceptable in their intended contexts, but not necessarily workable in the other contexts. While "agility" is probably a useful recommendation in both contexts, what "agility" means in these contexts may differ to some extent.



〈Fig. 3〉 Future research perspectives emerging from the three clusters of research and their possible shared interconnections

Our proposition for future research is therefore to differentiate extreme contexts from normal contexts. We see from this literature review that prior research in clusters 1 (software development) and 2 (supply chains) has been primarily interested in volatile situations that we call here extreme contexts. Such situations may have to, for example, sacrifice rigorous planning and fixed structures

for guidelines and prioritization of critical resources and information channels. We suggest that future research may usefully distill from recommendations made in these clusters to develop an agility concept for particularly challenging conditions, including those characterized by changing user requirements, material suppliers, and transportation routes, but also potentially other kinds of volatile situations.

Another definition of "extreme contexts" could be those which involve acute incidents such as emergency response services, space exploration, military operations and nuclear energy organizations. In such organizations there is an occurrence of events leading to intolerable magnitude of physical, psychological, or material damage (Hannah et al., 2009) in case of failure. Organizations operating in this kind of extreme environments rely on predefined procedures and careful planning, but they also require the capability to adjust their operations in unknown events and situations to avoid or minimize the damage. Hence, it is the dangerous nature of the work done in these organizations that defines the environments as "extreme". Previous research in all three clusters has been conducted in rather traditional business organizations (except, perhaps that regarding humanitarian supply chains). This kind of extreme contexts allude, for example, to the work of Karl Weick, as evident in his work on high reliability organizations, and the associated concepts of mindfulness and sense-making (Weick, 1995). A number of papers have been published about the linkages of agility and mindfulness, but they have not been explored to any depth so far.

On the other hand, our view is that the research done in cluster 3 has been interested in conditions that are characterized by the words "new normal", where the business environment has changed to become more volatile, but where planning and structures are still valuable and even necessary tools. Agility as discussed in this cluster is a shift in management thinking that applies to organizations facing an environment where customers have become more discriminating and competition has become more intense. When a firm finds itself in such conditions, it may have no choice but to "level up" by using the agility enablers given in the cluster, with the gear shift being possibly a permanent adjustment, since the whole marketplace has undergone a transformation.

We have noted the second trigger for agility to be dynamic capabilities. In past research they are to be found primarily linked to cluster 3, although there are some references to the dynamic capability theory in the definitions of agility in cluster 2, as well. The fundamental issue with dynamic capabilities in agility research is that the notions of dynamic capabilities and agility are not explained in relation to one another. Most papers assume that the notions are one and the same, or very similar, but many papers also base their agility definitions on other theories than dynamic capability theory. Future research should strive to more accurately define what agility means, what are the assumptions behind agility, and how to create agility.

We also propose that agility enablers further develop two categories of constructs; that of network

agility and micro level of analysis or downstream research (Figure 3). The former, network agility, refers to the agile management of a network of actors. A network may consist of communicating and collaborating individuals or be a computer network. In the case of clusters 1 and 3, network agility can denote research into information systems development conducted by distributed teams connected through IT (Batra et al., 2011), whereas in cluster 2, supply chains naturally form a network of actors. However, that said, the concept of agility is more typically explored in the context of a single organization. This is prevalent even in the second cluster which focuses on the supply chain. While supply chain agility implies that empirical research should examine the whole of an organization's supply chain (which could relate to a single product or service among a product/service portfolio), researchers have often limited their focus on supply-related functions of a single enterprise (e.g., Gligor et al., 2015).

As today organizations operate often in networks of multiple organizations, future research should investigate whether agility can be achieved at the network level, where a network is formed from different organizations. In addition to the ones found in this study, it would require additional unit of analysis that is network level enablers. For this purpose, supply chain research provides great potential. However, the fact that research designs in the agile SCM cluster thus far use greatly simplified representations of SCM concepts, focusing on the organization rather than the network, network agility promises a more ambitious research agenda for this cluster than has been realized to date. Alternatively, future research could generalize this area to discover the conditions for not only software development teams, but any distributed work teams, to become agile.

The category of micro-level analysis/downstream research refers to the examination of individual- and team-level behavior in organizations that underpins the wider organizational outcomes and generates organizational-level agility in particular circumstances. Such individual- and team-level behavior is also a prerequisite for the formation of dynamic capabilities (Bojesson, & Fundin, 2020). This perspective is natural in Cluster 1 due to it focusing on software development teams; however, it is also evident in a number of papers in Cluster 3, although being conspicuously absent from Cluster 2. Like Cluster 3, research in Cluster 2 tends to address the organizational level, and there is no clear reason why the micro-level is missing in this cluster. It is within reason that excellent supply chain management teams could contribute to SCM agility. Future research could investigate the extent to which micro-level behavior is a determinant for agility in the case of managerial and employee behaviors, since both of these are critical to agility. It could also tease out the agility-related behavioral differences for information technology professionals, supply chain management professionals, and the general management. Lastly, considering that micro-level actions in agility are discussed in both the dynamic capabilities research as well as in agility research, it is reasonable to expect some clarification to the relationship between these concepts in the future.

In this review risk, environmental dynamism and constrained time frame are found to be major triggers of agility in all three clusters. But there is a possibility that trigger for agility to be managerial fashion (Cram & Newell, 2016). In software development, software firms and IT departments are widely adopting agile methods, putting pressure for organizations to experiment with it, without being explicit about the need for agility. Even more broadly, practicing managers in many organizations are using "agility" as one desirable objective, without a precise meaning. The same is true in technology and strategy, and supply chain management domains. Fashion driven adoption of agility initiatives can even backfire due to unnecessary resource commitment and opportunity lost. It means there is a possibility that agility in some cases can cause performance loss. We suggest that future research should pay specific attention to negative implications of agility, particularly on the identification of conditions under which agility might not give a return on investment.

Finally, we identify digital firms, and industries undergoing digital transformation (Vial, 2019), as targets for empirical research. A characteristic feature of digital firms is that their value offering comprises a digital or data enabled component. This change in value offering leads incumbent firms in traditional industries like banking, media or manufacturing, to compete and collaborate with large digital firms, software firms, and digital start-ups. In this context, holding capabilities of owners and senior management, software development teams, digital infrastructure teams, and teams responsible for supply chains, as separate is not likely to be useful. Hence, similar to high-tech industry in the 1990s that provided the initial context for dynamic capability and agility, we consider digital firms and converging digital markets as a context where merging the insights from dynamic capability research and agility research is no longer just an option, but a necessity.

Ⅵ. Lessons learned for businesses

While we believe our research will be mainly beneficial for scholars pursuing further breakthroughs in agility, there could be some lessons learned for businesses as well.

Firstly, our research indicates that agility-related recommendations in the literature are linked to contexts and assumptions that should be taken into account by firms. To be specific, we have identified three clusters of agility research aiming to prescribe recommendations for different kinds of contexts: the software development context, the supply chain management context, and the strategic application of information technology context. It should be recognized that not all firms operate in internal or external environments which warrant agility, but if they do – and this paper should work as a reminder – then they can check which of these contexts best applies to their

circumstances before trying to apply agility prescriptions. To do this, firms can consult Table 1 for an outline of the three contexts, asking themselves if it is uncertainties in user requirements, the supply chain, or competition that is most pertinent to them. Then they can follow the appropriate column to gain broad insights on that context.

Secondly, we specify three distinct groups of ways (see Table 1) to build agility in each of the three contexts: managerial behaviors, employees and teams, and structures and cultures. From these groups, organizations can learn the basic logic for how that context generally prescribes improvements in agility. Hence, Table 1 serves as a checklist whereby firms can see whether they are already following the prescribed logic in that context or not. Further refinements are available by consulting the literature cluster in more detail, and our paper offers relevant samples from each cluster in section 3.

Thirdly, our findings include different implications for agility in the three contexts that can help organizations by showing how agility has been measured in the contexts. Thus, the concepts here can enable organizations to set up their own indicators for tracking agility amid organizational changes and improvements, and therefore provide a tangible way of progress evaluation. Table 1 also shows that critical organizational measures have been linked to agility, demonstrating the value of agility prescriptions in the appropriate contexts and hinting at ways to argue the value of agility to senior management.

Ⅶ. Conclusion

The objective of this paper was to present a consolidated picture of emerging research on agility in organizations and present future research directions. Building on the bibliometric technique of bibliographic coupling we identified three main clusters of research — software development, supply chain management and information technology and strategy — which are currently dominating the agility research. Research in these clusters suggests that individual, teams, managers and structural aspects are the dominant enablers of agility and hence most agile practices are centered around these enablers.

An important contribution of this study is to create a bridge between different streams of research conducted in relevant nevertheless different fields. Previous research lacks any effort to develop a comprehensive understanding of links between emergent research on agility conducted in different fields. Second, this study also shows that development of agility in organizations has sustained importance over the years. It is often studied in the context of technology whether in creation of technological products or utilization of technology for developing agile practices. As technological

advancements grow and also organizations need to be more flexible and responsive, agility continues to be an important topic for coming years. In this regard clarification of intellectual structure and development of agenda for future research may guide researchers to examine agility in a focused and systematic manner. Third, reinvention of wheel or repetition of similar ideas happen often when a phenomenon is explored in different contexts. Identification of potential avenues for cross proliferation of ideas across different streams of research means less probability of development of agility discourses in isolation. Finally, in terms of methodology, bibliographic coupling is an innovative approach particularly suitable for capturing emerging research streams in a systematic and quantitative way. Consequently, mapping of intellectual structure of research on agility in organizations emanating from this study are more reliable and less prone to researcher bias and subjectivity commonly found in traditional qualitative literature reviews.

This research is not without limitation. Although bibliometric methods have gained popularity in management research, they have some common drawbacks. Bibliographic coupling depends heavily on citations analysis which means articles with the same author or lengthy list of references might get overrepresentation. Moreover, selection of threshold can increase or decrease the number of studies in the final sample which can influence inclusion of niche areas of research. Nevertheless, threshold-based distortion was not noted in this study as we applied different thresholds to check its influence on overall shape of network of clusters. Regardless of limitations we believe that present study provides a logical and insightful discussion on emerging streams of research and hence makes a robust contribution to existing research on agility in organizations.

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조직의 민첩성: 최신 기술에 대한 서지 조사

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〈요 약〉

유연성에 관한 연구는 1990년대부터 인기를 얻기 시작했으며, 수년에 걸쳐 교차 영향이 거의 없는 여러 별도의 흐름으로 병합되었다. 이에 따라, 개별 연구 흐름 전반에 걸쳐 유연성에 대해 학습 내용을 증강하는 것이 어려워졌다. 많은 수의 정성적 연구가 있었지만, 유연성에 대한 총괄적으로 평가를 내일 수 없었다. 반면, 본 연구에서는 서지결합 접근법을 사용하여 조직의 유연성에 대한 체계적인 문헌 검토를 수행하였다. 본 연구에는 유연성에 관한 (1) 소프트웨어 개발 유연성, (2) 공급망 관리 유연성, (3) 전략적 IT 유연성 등의 세 가지 주요 연구 클러스터(집단)를 발견하였다. 이 연구 결과에 따르면 정보기술은 유연성에 관한 연구에 주요한 기여를 하고 있으을 보여준다. 향후 연구를 위한 방법으로 이러한 클러스터의 아이디어를 결합하는 유연성에 대한 공유된 관점을 제안하였다. 이러한 관점은 유연성에 관한 연구를 발전시킬 수 있으며, 특히 새롭게 떠오르는 특정 관리 영역에서 이론화를 위한 경로를 제공할 수 있었다.

키워드 : 민첩성, 동적 능력, 문헌 검토, 서지적 결합

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