DEVELOPING INTELLECTUAL CAPITAL WITHIN AGILE IT TEAMS: A LITERATURE REVIEW

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DEVELOPING INTELLECTUAL CAPITAL WITHIN AGILE IT TEAMS: A LITERATURE REVIEW

Research paper

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Abstract

Since the Agile Manifesto was presented in 2001, more and more organizations move from traditional, plan-driven software development to agile approaches. This movement is motivated by the fact that environments are changing quickly and new requirements need fast implementation. We conducted a structured literature review to identify the current state of knowledge about agile IT teams and how they develop ambidextrous organizational learning to respond to rapid changes. We draw on the intellectual capital theory with the aim to explore key capabilities of agile IT teams of prior research. Afterwards, we synthesize the key capabilities considering intellectual capital. We derive intellectual capital configurations that enable IT teams to develop ambidextrous organizational learning. Furthermore, we identified technological oriented capabilities of infrastructure flexibility and architecture modularity for agile IT teams. Therefore, we built the concept of technological capital and arranged these capabilities. Thus, this study contributes to research by highlighting the characteristics that enable IT teams to be agile and thus helping companies to gain competitive advantage. Furthermore, we discuss possibilities how balance in ambidextrous organizational learning could be achieved. Additionally, we provide further research opportunities in this research stream.

Keywords: Agile IT teams, ambidextrous organizational learning, intellectual capital, literature review

1 Introduction

Following the publication of the Agile Manifesto in 2001, Agile Software Development (ASD) methodologies became very popular (Vial and Rivard, 2015) as they provide an effective method to react to rapidly changing customer requirements in challenging environments (Hummel et al., 2013b). Hence, more and more organizations decided to move from plan-driven software development to agile approaches (Dybå and Dingsøyr, 2008; West et al., 2010; Tripp et al., 2016). Agility is defined as “the ability to respond operationally and strategically to changes in the external environment” (Fink and Neumann, 2007, p. 444). One of the most important differences between organizations that follow agile approaches and organizations that follow more traditional approaches is that they establish autonomous, self-organized teams, facilitate learning beyond knowledge silos and thus, facilitate and advance decisions-making within these teams (Coyle et al., 2015). For example, Amazon and Spotify replaced their traditional “silo” functions, which required enormous coordination efforts, with autonomous, cross-functional, product-centric teams that include a maximum of eight people (Advance IT Minnesota, 2016). This enables them to gain, share and implement knowledge, speed up decision making processes significantly and thus, to meet demand in rapid changing environments (Ramesh et al., 2012).

Developing innovative capabilities and realizing agile IT structures frequently enables companies to gain competitive advantages (Ramesh et al., 2012). However, companies need to be able to implement
agile approaches to benefit from higher agility as reflected by shorter development cycles and strong collaboration within the IT team (Kude et al., 2014). This seems to be difficult for rather old-fashioned companies. In contrast to modern organizations like Amazon and Spotify, these companies are more likely used to long software delivery lifecycles resulting from strict procedures and the realization of predefined plans (Fitzgerald, 1998; Sommerville, 2009; Kude et al., 2014; Coyle et al., 2015). In other words, these companies are quite effective in utilizing plans to refine and exploit existing knowledge, but have difficulties to bridge knowledge boundaries.

Prior research noted that organizational learning—the process of adoption and integration of new knowledge—is critical for realizing change (Kang and Snell, 2009). Since the publication of March (1991) a lot of investigations on organizational learning concentrate on the approaches of exploration and exploitation (Kang et al., 2007; Kang and Snell, 2009). Exploration is defined as the learning of new knowledge outside from companies knowledge stocks, whereas exploitation focus on improving and deepening existing companies knowledge domains (March, 1991). But firms are struggling to practice exploration and exploitation together. Hence, literature emphasizes the concept of ambidexterity within organizations to balance both, exploration and exploitation (Gupta et al., 2006) to foster organizational learning (March, 1991). Furthermore, ambidextrous learning is contingent on an organization’s intellectual capital (IC). The several dimension of IC, human, social, and organizational capital play a significant role within the learning process (Kang and Snell, 2009).

In order to develop the ability to respond to changes in the external environment (i.e., the ability to be agile), IT teams need to perform ambidextrous learning that is balancing exploration of new, as well as exploitation of existing knowledge and related resources (Lee et al., 2015). Although there is much literature on agile development teams, IS research is hitherto not clear on how IT teams could be enabled to develop this ability. To contribute to this gap, this paper sets out to synthesize prior research to illuminate how IT teams can be enabled to develop the ability of ambidextrous learning regarding the dimensions of IC. The following research questions guide this effort: How can IT teams develop ambidextrous organizational learning capability to respond efficiently to environmental changes?

We conducted a structured literature review to summarize the current state of knowledge and to approach this question. We analyze the findings of prior literature considering intellectual capital theory. More precisely, we analyze characteristics of agile teams that prior research has identified. Ultimately, we derive IC configurations that enable IT teams to develop ambidextrous organizational learning based on the approach of Kang and Snell (2009). Thus, this paper contributes to prior research by highlighting the characteristics that enable IT teams to be agile and thus, helping companies to gain competitive advantage.

The remainder of this paper is structured as follows. First, we discuss our theoretical understanding of agile IT teams, intellectual capital theory and ambidexterity in organizational learning. Then we outline our methods, present our findings and discuss the theoretical and practical implications of this research.

2 Theoretical Background

2.1 Agile IT Teams

Software development methodology is defined as an advocated approach for phases, rules, techniques, processes, documentation and training, employed for developing a software (Avison and Fitzgerald, 2003). In traditional development approaches, a sequential progression of phases is used and tasks are given to individual persons within separated organizational entities (e.g., business analyst unit, developer unit). Furthermore, this approach requires a huge amount of documentation, and much communication between the project participants is formalized through that documentation (Nerur et al., 2005).

Many of rather traditional structured IT organizations move to an agile, product-oriented structure of their entities to enable rapid software development. Normally, organizational entities are structured along several agile teams. An agile IT team is defined as a group of colleagues that work together with
the aim to alter a running software or to build a new information system. Agile IT teams usually utilize agile methodologies such as Kanban, or Scrum, which create new possibilities to react fast with short development cycles and deliver software features iteratively to change customer or market requirements (Maruping et al., 2009).

Within agile IT teams all members should be able to perform all activities that are required to achieve the team objectives. Thus, members of agile teams should develop and advance a broad set of capabilities such as development, architecture knowledge, project management capabilities, and system administration (Tripp et al., 2016). Moreover, teams need to engage in continuous organizational learning processes to increase their performance. On the one hand, they are in the need to continually exploit existing knowledge, skills and capabilities (i.e., existing intellectual capital) and, on the other hand, to explore new knowledge such as that of their colleagues and customers (i.e., enhanced intellectual capital). Prior research shows that teams, which implement learning processes on group level early on, outperform other teams concerning both effectiveness and efficiency (Spohrer et al., 2012). Below we discuss the concepts of organizational learning and intellectual capital.

### 2.2 Intellectual Capital and Organizational Learning

Organizational learning consists of gaining, sharing, and integrating knowledge from outside the firm, as well as internal knowledge to improve on “actions through better knowledge and understanding” (Fiol and Lyles, 1985, p. 803). March (1991) provided a seminal of organizational learning that presents the trade-offs between exploration and exploitation, this model is widely used by existing literature (e.g. Gupta et al. (2006), Crossan et al. (1999)). Organizational learning appears on individual, group, and organizational level (Crossan et al., 1999; Kang and Snell, 2009) and involves the ability for exploitation and exploration. Exploitation focuses on a close, local, and deep search with repeating mechanisms to identify adequate solutions appropriate to firm’s existing knowledge. Exploration is the result of a wide and generalized search to extend the knowledge fields of an organization into novel domains (Kang and Snell, 2009). The concept of ambidexterity refers to the ability to balance both exploration and exploitation. Consequently, literature on organizational ambidexterity focuses how these can be coordinated (Gupta et al., 2006).

As discussed above, agile, cross-functional IT teams are in the need for both exploration and exploitation within their teams (Ramesh et al., 2012). They need to exploit their skills and knowledge to develop the system in time and on budget. Organizations are able to encourage learning within subunits, since this could lead to the exploration of new possibilities (Fang et al., 2010). Moreover, they need to sense the environment, acquire new knowledge and skills to sense or anticipate, understand and respond to emerging changes (exploitation) (Cao et al., 2009). Firms need an ambidextrous learning structure whereas they explore opportunities for new service development, as well as efficiently exploit existing products and services (O’Reilly and Tushman, 2008; Fang et al., 2010).

Prior research shows that organizational entities’ abilities to develop or enhance organizational learning is closely tied to their knowledge inventory. In this regard, IC reflects this knowledge inventory, involving knowledge resources and capabilities of the networks the organization is embedded in. Consequently, IC refers to the combined knowledge that organizations can draw on to create a competitive advantage (Nahapiet and Ghoshal, 1998; Subramaniam and Youndt, 2005; Wang et al., 2014). Concerning IT teams, it can be assumed that their ability to develop ambidextrous learning and thus to respond to changes in the external environment (i.e., the ability to be agile) is contingent on their IC.

Prior research has contributed a broad range of conceptualizations of IC. The perhaps most-widely accepted framework conceptualizes IC as consisting of three dimensions: human capital, social capital, and organizational capital (Subramaniam and Youndt, 2005). These dimensions reflect knowledge domains which are aggregated and distributed among the organization, its individuals, and on relationships between individuals (Subramaniam and Youndt, 2005; Kang and Snell, 2009). We assume that there are IC configurations that contribute to the ability of IT teams to develop both forms of organizational learning, exploration as well as exploitation and thus enable them to be agile. Kang and Snell (2009) provided a multilevel model of the dimensions of IC and discussed how they can be combined.
to foster ambidextrous organizational learning. Their research based on March (1991), they present two alternatives for each dimension of IC. Below we discuss the dimensions of IC and their alternatives.

Human capital refers to the combined knowledge of the individuals within a firm. This dimension encompasses the knowledge, capabilities as well as skills, and abilities which belong to and are used by the individuals (Subramaniam and Youndt, 2005). Concerning organizational learning, human capital can be either specialist and generalist in nature. Specialists possess deep, bounded, and embedded knowledge in special domains, whereas generalists are multi-skilled, can draw on a manifold repertoire of competencies and are able to apply these in different knowledge domains (Taylor and Greve, 2006; Kang and Snell, 2009). Specialized human capital may be accompanied by a functional bias which can decrease individual readiness and ability to vary and change new knowledge within their specified domain (Dougherty, 1992). Hence, specialists might rather focus on exploitation and ignore exploration (Kang and Snell, 2009). Generalists are more broadly oriented in various knowledge domains, generalist human capital has less functional bias. Furthermore, they can provide multiple solutions for a problem and apply, discover, and combine new knowledge. Subsequently, generalist are rather likely to focus on exploratory learning (Taylor and Greve, 2006; Kang and Snell, 2009).

Social capital reflects the knowledge that is available via relational networks. It is the pipeline for knowledge exchange and combination within the company. Firms can gain advantages through sharing knowledge and insights and/or mental models within working groups and social relationships (Nahapiet and Ghoshal, 1998; Kang and Snell, 2009; Karahanna and Preston, 2013). In this regard, Ghobadi and Mathiassen (2016) show that shared knowledge and communication within agile IT teams can positively influence project success, failure rates, and risk factors. Social capital comprises three dimensions; structural, relational, and cognitive (Nahapiet and Ghoshal, 1998; Wagner et al., 2014). The structural dimension encompasses the overall scheme of network connections between individuals. This includes the communication settings between IT employees and other employees in form of meetings etc. (Wagner et al., 2014). The relational dimension of social capital contains the interpersonal exchange among individuals e.g. trust. This dimension focusses on the relationships between the individuals, which is essential for knowledge exchange and combination. The cognitive dimension implies to the degree of shared representations, understanding of individuals, and shared knowledge among individuals. Structural linking enhances relational and cognitive linkage and complete each other and social capital delivers the possibility for knowledge exchange (Nahapiet and Ghoshal, 1998; Kang and Snell, 2009; Karahanna and Preston, 2013). Prior research identified two generic social capital configurations: the cooperative and the entrepreneurial relational archetype of social capital. The cooperative relational archetype may facilitate exploitations as it involves strong and closely connected social networks characterized by strong trust and shared understanding (Kang et al., 2007). In contrast, the entrepreneurial relational archetype refers to more loosely coupled social networks. It enhances flexibility that is required to extent, gain, and absorb new knowledge and hence, it is expected to facilitate organizational exploratory learning.

Lastly, organizational capital refers to the institutional knowledge that is embedded in processes, structures, and systems. Organizational capital captures and integrates individual knowledge into organizational knowledge to be less dependent on individual employees (Grant, 1996; Kang and Snell, 2009). Based on prior literature, organizational capital can be categorized into two types: mechanistic and organic organizational capital (Kang and Snell, 2009). Mechanistic organizational capital refers to standardized structures and processes as well as tight rules. These are aimed at enhancing collaboration by determining enrooted patterns of interdependencies and providing detailed routines. Rules and standards facilitate integration of common opinions among colleagues. Thus, mechanistic organizational capital expected to facilitate exploitative organizational learning. Contrary, organic organizational capital refers to rather informal evolving rules, processes, and expectations about work results. Organic organizational capital enables continuous exploration, absorption and integration of novel knowledge (Kang and Snell, 2009) and is hence, related to explorative organizational learning.
Overall, prior research indicates that the ability to respond efficiently to environmental changes (i.e., being agile) requires ambidextrous organizational learning. Thus, we assume that characteristics of agile teams contribute to the ability of ambidextrous organizational learning. Ambidextrous organizational learning, in turn, seems to be contingent on the IC of an organization or organizational entity like an IT team respectively. Hence, we assume that there are IC configurations that facilitate ambidextrous organizational learning and help IT teams being agile.

3 Method

In general, literature reviews provide overviews on current states of research in distinct fields, synthesize existing knowledge and identify research gaps and unexplored research questions. As to that, reviewing literature is a necessary process in scholarship, which ensures that new research is connected to the existing body of knowledge within a research topic (Webster and Watson, 2002; Wolfswinkel et al., 2013).

Until now, no research was identified that synthesizes the characteristics that enable agile IT teams to develop ambidextrous organizational learning capability that are required to respond efficiently to environmental changes. Thus, we conducted a systematic literature review aimed at synthesizing the characteristics identified by prior research, to identify avenues for further research and to provide a framework that could guide such research.

The guidelines posed by Webster and Watson (2002) guided our efforts. Following their advice, we first defined criteria for inclusion or exclusion of articles. Our review explicitly focuses on characteristics that enable IT teams to develop ambidextrous organizational learning and hence contribute to their ability being agile. More precisely, we aim to come up with a classification of intellectual capital that enables agility. Hence, the emphasis of this review is on past investigations of the design of agile organizational entities related to IT (e.g., IT teams and IT departments). Particularly, we were looking for articles describing characteristics of intellectual capital of IT related organizational entities that enable ambidextrous organizational learning. Table 1 presents our criteria for excluding papers.

<table>
<thead>
<tr>
<th>Reasons for exclusion</th>
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<tbody>
<tr>
<td>Research with strong focus of traditional IT teams/functions</td>
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<tr>
<td>Research that give no insights into agile information systems development</td>
</tr>
<tr>
<td>Research with strong focus of organizational agility without delivering any insights into agile IT teams</td>
</tr>
<tr>
<td>Research which deliver no attributes/capabilities/components or insights for the design of agile IT</td>
</tr>
</tbody>
</table>

Table 1. Exclusion criteria.

Webster and Watson (2002) recommend to start the literature search with important journals and conference proceedings and to conduct a forward and backward search of selected articles. Since keywords like “agile”, “agility” and “IT or IS teams” resulted in too many irrelevant articles, which, in turn, increases the chance of missing articles that prove value to our research questions, we decided not to use a key-word based search strategy. Rather, we decided to manually scan the table of contents of premier IS research journals from North America and Europe (Schwartz and Russo, 2004; Wolfswinkel et al., 2013). Following the advice of Webster and Watson (2002), we identified relevant articles by scanning the title and abstract of each article within the selected journals and conference proceedings. If heading, key words and abstract suited our criteria, papers were included for further review. Following this strategy, 93 articles have been identified.

We included eight journals recommended by the Association for Information Systems (AIS) senior scholars group in 2011 (i.e., the senior scholars basket of eight) plus MISQ Executive. We included the latter one because it contains frequently cited practice based publications in IS and is well respected in practice and academia. Furthermore, we included the past five years of the conference proceedings of the International Conference on Information Systems (ICIS) and the European Conference on
Information Systems in our analysis (ECIS). By including the A- or B-rated conference proceedings, we intend to ensure that our literature review captures the latest research, which is not yet published in journals. We started our search in 2001, the year the Agile Manifesto was presented. We scanned all identified, published articles (93 articles) as described above and applied our exclusion criteria. Overall, 45 papers have been excluded. For the remaining 48 articles, we performed a backward research by checking the articles cited within the paper. Moreover, we used Web of Science and Google Scholar to perform a forward search to identify articles in other journals that cited these articles. These results have been analyzed using the same inclusion and exclusion criteria resulting in another 16 articles included in our analysis. In summary, we selected 64 papers (see Table 2).

<table>
<thead>
<tr>
<th>Journal</th>
<th>Coverage</th>
<th>Hits</th>
<th>Included</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIS Quarterly</td>
<td>2001-2016</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Journal of Strategic Information Systems</td>
<td>2001-2016</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Journal of Management Information Systems</td>
<td>2001-2016</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Journal of Information Technology</td>
<td>2001-2016</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>European Journal of Information Systems</td>
<td>2001-2016</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>Information Systems Journal</td>
<td>2001-2016</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Information Systems Research</td>
<td>2001-2016</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Journal of the AIS</td>
<td>2001-2016</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>MIS Quarterly Executive</td>
<td>2001-2016</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>International Conference on Information Systems</td>
<td>2011-2016</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td>European Conference on Information Systems</td>
<td>2011-2016</td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td>Others Sources (forward/backward search)</td>
<td></td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

Table 2. Considered sources and number of identified articles.

We coded the selected papers following the guidelines of Webster and Watson (2002). To mitigate the risk of coding bias, the research team has developed rigor rules that guided the coding and analysis process. One researcher went through the paper and coded passages covering information about the focus and theoretical base of the paper, considered characteristics of agile IT teams and the primary findings. During analysis, regular meetings were set up to discuss emergent findings, issues and divergent views, until agreement regarding the constructs reflecting intellectual capital dimensions has been achieved.

4 Findings

Several researchers investigated different settings of agile IT departments or agile IT teams (Fink and Neumann, 2007; Baumgart et al., 2015; Vial and Rivard, 2015; Tripp et al., 2016). Analyzing and comparing the theoretical and empirical findings of these papers, we could identify eleven distinct characteristics related to intellectual capital, which help to foster ambidextrous organizational learning and thus, agility within organizational IT entities. The three dimensions of IC provide means for structuring the findings. Overall, literature confirms our assumption that IT teams need to employ both forms of organizational learning in order to be agile. Furthermore, we identified technology-oriented capabilities that could not be structured in one of the dimension of IC. Consequently, we added a technological capital dimensions. However, one could argue that technology could be closely related to the organizational dimension, we find much value in separating technological capital. Particularly since we are concerned with the IC of IT-related organizational entities.

Several papers within human capital related characteristics of agile IT teams like diversity, attitude, and requirements understanding. For example Lee and Xia (2010) highlighted, that agile IT teams that
have a great diversity are more effective in responding to rapid environmental chances than homoge-
nous teams. Literature emphasizes that the agile software teams’ variety should fit the environment in
which it is embedded, because diversity enhances the team's ability to react to changing environments.

**Social capital** encompasses the constructs shared knowledge, communication, as well as trust. Pries-
Heje and Pries-Heje (2011) found that agile IT teams use effective communication ways and create
trust. They conclude that this fosters social team capital. Social capital enhances IT teams understand-
ing of business. Hence, this fosters knowledge exchange, enhances collaboration and accelerates
strong ties within a network. Additionally, the team can achieve a better understanding of customer
requirements through shared knowledge, trust, common language and communication (Wagner et al.,
2014).

We identified governance, environment dynamism, and agile methodology use as constructs for agile
IT teams that reflect characteristics of **organizational capital**. For example, Tiwana and Konsynski
(2010) argue that enhancing agility is possible through IT governance decentralization. IT perfor-
mance can increase through easing the exchange within an IT department (e.g. through decentraliza-
tion).

Concerning **technological capital**, we found that prior research particularly investigates how infra-
structure flexibility and architecture modularity enables agility. For example, new trends in technology
faces infrastructure with great challenges, hence, a high degree of flexibility plays an essential role
within agile IT teams. Prior studies associated IT infrastructure flexibility with fast business changes
(Broadbent et al., 1999; Salmela et al., 2015), and enhanced organizational responsiveness (Bhatt et
al., 2010; Salmela et al., 2015). These advantages are delivered by agile IT teams.

The following Table 3 presents the findings from the literature review structured per IC.

<table>
<thead>
<tr>
<th>Human Capital</th>
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<tbody>
<tr>
<td><strong>Characteristic</strong></td>
</tr>
<tr>
<td>Diversity</td>
</tr>
<tr>
<td>Attitude</td>
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<tr>
<td>Requirements understanding</td>
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</table>
### Social Capital

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Definition of Construct</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shared knowledge</td>
<td>Is defined as the team members shared, organized understanding of knowledge of essential key elements, roles and responsibilities, as well as tasks and skills of the environment of the team.</td>
<td>(Sambamurthy et al., 2003; Schmidt et al., 2014; Ghobadi and Mathiassen, 2016)</td>
</tr>
<tr>
<td>Communication</td>
<td>Is defined as the effective way to convey information between the team members. A clear communication and coordination process is dependent from the agile methodology use and is essential to avoid conflicts and redundant work. Agile team communication increases team members exchange frequency through short daily meeting, customer talks, and face-to-face communication.</td>
<td>(Hovorka and Larsen, 2006; Harris et al., 2009; Botzenhardt et al., 2011; Torkar et al., 2011; Li and Maedche, 2012; Wang et al., 2012; Hummel et al., 2013a; Scheerer and Kude, 2014; Schlauderer et al., 2015; Vial and Rivard, 2015; Tripp et al., 2016)</td>
</tr>
<tr>
<td>Trust</td>
<td>Is defined as the ability to show widespread respect and to have a trustfulness relationship between two individuals or within the agile IT team.</td>
<td>(Baskerville and Pries-Heje, 2004; Dybå and Dingsøyr, 2008; Goh et al., 2013; Matook and Maruping, 2014; Baumgart et al., 2015)</td>
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</table>

### Organizational Capital

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Definition of Construct</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governance</td>
<td>Is defined as the degree of decentralization of decision-making authority within self-organized team-based structures of the IT department. Further, agile IT teams have a great autonomy in the decision making power.</td>
<td>(Tiwana and Konsynski, 2010; Balaji et al., 2011; Botzenhardt et al., 2011; Torkar et al., 2011; Coyle et al., 2015; Krancher and Luther, 2015)</td>
</tr>
<tr>
<td>Environment dynamism</td>
<td>Is defined as the agile IT team shared perceptions of practices, techniques, and procedures of an organization that are used to react on unpredictable and rapid changes of customers’ preferences.</td>
<td>(Watts and Henderson, 2006; Sarker et al., 2009; Lee et al., 2015; Lowry and Wilson, 2016)</td>
</tr>
<tr>
<td>Agile methodology use</td>
<td>Is defined as the extent to which the IT team uses agile software development methods as well as agile project management practices. Agile methodologies facilitate the rapid application development; have as little as possible documentation, active involvement of customers, and interaction and feedback processes as well as a strong focus on short cycle releases.</td>
<td>(Baskerville and Pries-Heje, 2004; Fitzgerald et al., 2006; Fruhling and Vreede, 2006; Ågerfalk et al., 2009; Balijepally et al., 2009; Cao et al., 2009; Mangalaraj et al., 2009; Maruping et al., 2009; Wang et al., 2012; Tripp et al., 2016)</td>
</tr>
</tbody>
</table>
### Table 3: Findings of the literature review: Key constructs of agile IT teams.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Definition of Construct</th>
<th>References</th>
</tr>
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<tbody>
<tr>
<td>Technological Capital</td>
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<tr>
<td>Infrastructure flexibility</td>
<td>Is defined as the ability of an IT team to react quickly and cost efficiently to customer demands. The infrastructure is flexible and compatible for emerging technologies and able to support running systems.</td>
<td>(Fink and Neumann, 2007; Bush et al., 2010; Goh et al., 2013; Rdiouat et al., 2015; Salmela et al., 2015)</td>
</tr>
<tr>
<td>Modular architecture</td>
<td>Is defined as the degree to which an IT team can work within an architecture that disaggregated into autonomous subsystems to foster communication through standardized interfaces. This encompasses the loose coupling of applications, which means that changes in one system does not affect another system as well as competencies in emerging technologies.</td>
<td>(Fink and Neumann, 2007; Choi et al., 2010; Tiwana and Konsynski, 2010; Yang et al., 2016)</td>
</tr>
</tbody>
</table>

The framework resulting from these findings is presented in Figure 1 below:

![Figure 1: Findings: Four dimensions of key constructs.](image)

The literature review largely confirmed our assumption. The results show the characteristics of agile IT teams contribute to ambidextrous organizational learning, which is dependent from IC. In the following, we present our findings for the different configurations of IC as well as for technological capital.

**Generalist vs. specialist human capital:** During the literature review, the research team identified different constructs, which reflect human capital characteristics. Individuals are important to uncover organizational boundaries and hence, foster the ability to receive and apply knowledge (Subramaniam and Youndt, 2005). Within agile IT teams, individual people with requisite special skills are one of the most important factors for a successful mode of operation. For example Chow and Cao (2008) explained that people based skills like high competency (diversity) are required to complete an agile project on time. This research shows that both aspects of human capital of organizational learning need to be given within agile IT teams. Furthermore, team members need an attitude, which is compliant with the mode of operation of the team. The team members need a commitment about the agile setting (Cao et al., 2009). Additionally, agile IT teams need general knowledge across a broad range of tasks that...
need to be delivered by the team (e.g. requirements understanding). IT teams should be able to rep-resent all roles of their team that are necessary to complete their responsibilities (Tripp et al., 2016). This is a typical characteristic of exploration in organizational learning. Overall, our review indicates that agile IT teams need not just special knowledge in different topics and not only generalist understanding. Within an optimal setting, agile teams require a sufficient combination of both types of human capital. Thereby, the team should have a great diversity of skillsets to understand the customer’s requirements, but also special knowledge to find the right solutions with the help of a motivated attitude to work with agile methods and react fast to moving environments.

**Cooperative vs. entrepreneurial social capital:** Prior research exhibits that success depends on the individual ability and willingness to work together to generate advantage for the company (Subramaniam and Youndt, 2005). Communication, shared knowledge, and trust play crucial roles for good collaboration within cross-functional teams. The challenge is to implement strong ties over all three dimensions of social capital within the team, namely structural, relational, and cognitive. Literature highlights that the individual knowledge of a particular team member should be shared among members of the agile group to learn from each other, and thus, foster group performance (Spohrer et al., 2012). Each team member should have close ties with the other team members (Pries-Heje and Pries-Heje, 2011). Agile IT teams need close cooperative ties between all members, which based on the individuals that have trust in each other to deliver exploitative learning. The entrepreneurial aspect of organizational learning is described by Sambamurthy et al. (2003) that agile IT teams have rather a strategic foresight, the ability to look ahead to changes within business environments. This describes rather weak ties to connection beyond the team. This emphasizes the entrepreneurial, exploration view of social capital. We recap that cooperative as well as entrepreneurial social capital should be implemented jointly within agile IT teams. To be ambidextrous, it is necessary to build strong networks within organizations to gain exploitation (Tushman and O’Reilly, 1996). Weak ties are important to achieve exploration in organizational learning.

**Organic vs. mechanistic organizational capital:** More and more teams are arranged decentralized within an organization. Consequently, new control, cultural and governance processes are required (Agerfalk et al., 2009). Coyle et al. (2015) highlighted that a governance structure should have two-levels to be agile: a strategic level to enable communication and coordination among the company, and an individual level to foster decision making in a team based structure. Within agile projects, it is necessary to make fast decisions to react on rapid environmental changes and thus, enhance communication. Literature shows that it is important for companies to integrate cross-functional teams within their IT department to foster organizational learning and gain better performance. Prior research depicted that teams outperform when a new product is developed by a responsible team on project level within the organization (Botzenhardt et al., 2011). Lee and Xia (2010) highlighted that agile development processes should be rather organic, dynamic, evolving instead of mechanistic, predefined and static. We summarize, that organizational capital of agile IT teams is on the one hand organic within the team level where the members must work autonomously and decisions have to be made quickly. This leads to exploratory organizational learning, because the teams search for new solutions and faster time to market delivery (Coyle et al., 2015). On the other hand, agile IT teams need predefined, mechanistic reporting lines for a suitable integration within the rest of an company (Botzenhardt et al., 2011). This contributes to exploitative learning, whereas the existing knowledge is consumed. Subsequently, agile IT teams need to balance forms of organizational learning to contribute to firm success.

**Static vs. dynamic technological capital:** Technological capital can be either static or dynamic. A strong strand of literature studied the trade-off between agility and stability, including issues related to exploitation and exploration (March, 1991; Gibson and Birkinshaw, 2004). Exploitation is associated with alignment, the degree how far the team fulfils customers’ requirements and quality expectations under given technological conditions. IT projects are often based on static and well-defined time and cost schedules (Tiwana, 2010; Cao et al., 2013). Agile IT teams have to react fast, cost efficient and flexible on customer demands and hence, exploit existing infrastructure possibilities (Fink and Neumann, 2007). Hence, the static dimension of technological capital was identified. In contrast, exploration is connected to loosely coupled systems and technologies (He and Wong, 2004; Vinekar et
al., 2006). Therefore, the dynamic dimension of technological capital was found. Agile teams work widely autonomously and should be able to decide which technology they use for their daily work. The teams need full flexibility to react quickly to changing environments and this may influence the group strategy (Li and Maedche, 2012). Highly modular systems enhance the ability to respond to changing markets (Tiwana and Konsynski, 2010). This contributes to explorative learning as the team is searching for new technologies to fulfil market demands. Additionally, system development projects must be aligned and controlled with client’s needs and cost schedules. To summarize, agile IT team must explore the market for new technologies and ensure that they exploit the present technological conditions so that the customers are satisfied. Hence, both forms of technological capital are necessary within agile IT teams.

5 Discussion

Our findings extend existing knowledge through a literature based overview of the settings of self-organized agile teams. Past literature primarily focused either on characteristics of agility, agile IT departments or connections of individual characteristics, for example autonomy or agile methodology use (Pries-Heje and Pries-Heje, 2011; Tripp et al., 2016). Hitherto, there is no research available that provides a broad overview regarding the characteristics of agile IT teams. Only a few researchers provide principles that go beyond single factors (Salmela et al., 2015; Tripp et al., 2016). The results show that teams could have different settings of organizational learning. Our findings present the optimal setting of agile IT teams in case of ambidextrous organizational learning. Nevertheless, teams could also have other IC configurations in case of imbalance. Teams that have imbalance within organizational learning could lay too much weight on one type of human, social, and organizational capital. For example, if members have too much concentration on specialist knowledge (human capital) e.g. in form of adherence of deep knowledge about prior roles or job function, they will be not able to fulfil the other team roles. For agile IT teams it is a prerequisite to represent all roles of their team to achieve high performance (Tripp et al., 2016). To counteract to this phenomenon, agile IT teams could lay the focus on more generalist human capital with the aim to gain greater skill diversity (Chow and Cao, 2008). Thereby, the team might be able to reach more balance in organizational learning.

Furthermore, the various dimensions of IC could influence each other. The focus should lay on all dimensions of IC. Specialist human capital may influence cooperative social capital. For example, a barrier for agility within IT teams could be the missing attitude of individuals towards the agile approach. If individual team members are not willing to work in agile environment this might have an impact on imbalance of organizational learning. Team members with missing attitude may dislike sharing knowledge. Hence, we emphasize that teams should motivate their members to foster their attitude (organizational capital) towards agility. If team members have a high attitude towards agile approaches and methods they might be more able to build strong ties and e.g. effective knowledge sharing (social capital) (Ghobadi and Mathiassen, 2016). This might lead to a higher degree of ambidextrous organizational learning.

As we mentioned above, we identified technological capital as necessity to develop ambidextrous organizational learning within agile IT teams. We decided to determine this new dimension in order to raise awareness for this dimension because we delivered contributions in a research area of information systems. In addition, technological capital should be balanced with the dimensions of IC. For example, technological capital should be closely coordinated with organizational capital. The challenge is to exploit technological conditions to be aligned with clients cost schedules (Cao et al., 2013) as well as explore new technologies to react fast on unforeseen environmental changes (Tiwana, 2010). This might be influenced by the governance structure of IT teams and the IT department in that it is positioned. In order to achieve ambidextrous organizational capital, agile IT teams should have a great decision making autonomy but need also strong, predefined reporting lines to abide to organizations targets and orientation (Botzenhardt et al., 2011; Coyle et al., 2015). Thus, we emphasize to align the various dimensions of capital to achieve ambidextrous organizational learning.
5.1 Theoretical Implications and Further Research

Analysing prior research and synthesizing characteristics of agile teams along IC dimensions that contribute to ambidextrous organizational learning capabilities helped to investigate the described gap. As to that, the framework and assumptions provide a starting point for further investigations considering the characteristics of agile IT teams, ambidextrous organizational learning and team performance. Further research may utilize the findings to relate different IC configurations to different levels of agility. Moreover, further research utilizing the framework would enhance our understanding on how IC of IT teams relate to their outcomes (e.g., alignment with customer needs, release frequency, etc.). Last not least, further research may investigate how the dimensions of intellectual capital related to ambidextrous organizational learning of IT teams reciprocally influence each other.

The present research highlighted that nearly all identified constructs could be ordered to IC. We identified a row of constructs within human, social, and organizational capital. Furthermore, we ordered the two constructs infrastructure flexibility (Salmela et al., 2015) and modular architecture (Tiwana and Konsynski, 2010; Cao et al., 2013) to the new dimension of technological capital. These aspects were identified as crucial factors within agile team settings. Additionally, we acknowledge two forms of technological capital, it can be static or dynamic. In addition, we found out that the combination of both forms is required to enhance the agility of IT teams.

We determine technological capital as separate dimension, because we like to show the importance of technological aspects within this area of information systems research. The given set of technology should be exploited as far as possible, but to achieve best and rapid solutions new technological possibilities should be explored. Hence, we complement existing research through characteristics of technological dimensions. Therefore, the presented framework could be enriched from further research, which investigates the correlation between human, social, organizational, and technological capital to enhance the theory.

5.2 Practical Implications and Further Research

We found out that IT departments who want to be agile need to balance IC with both forms of organizational learning. Kang and Snell (2009) suggested that the several dimensions of IC could be combined to enable a coexistence of exploitative and explorative organizational learning. We identified a row of constructs of agility that we ordered to the different dimensions of IC and to the characteristic of ambidextrous organizational learning. Forms of IC can be set into relation with each other and hence, foster internal alignment. Subsequently, we exhibit that self-organized agile teams must balance exploration and exploitation organizational learning of human, social, and organizational capital as well as technological capital.

We show that efficiency within these teams could be accelerated through the implementation of a set of skills and conditions if there is a clearing of exploration and exploitation. We highlighted that IC configurations that enable IT teams to develop ambidextrous organizational learning exist as a set of screws. Furthermore, we highlighted the necessity for ambidextrous organizational learning in case of technological capital. We depicted the static and dynamic dimensions. These screws can have different settings. We explained how these settings could be adjusted to gain higher balance of organizational learning.

Further research could explore possible configuration that might be applied in practise of the presented distinctions of organizational learning. For example, different combinations of constructs have different shapes in practise. The characteristic of human, social, organizational, and technological capital might vary in various organizations. The diverse settings of constructs of agile teams might lead to different outcomes. Additionally, further research might also consider alignment of the different dimensions within IT departments and their settings (agile, hybrid, or traditional).
5.3 Limitations

Though a structured literature search with the most relevant outlets in IS was performed, research in adjunct areas such as systems engineering might be also relevant to our research question. Subsequently, further research should include other research fields, and identify and analyze papers in outlets such as the Journal of Systems and Software. Second, the proposed synthesis reflects an extension of the few available typologies to characterize agile IT teams. However, until now, the concepts are solely grounded in prior research and need further theoretical amplification. Third, the concrete manifestation of the characteristics proposed above, their interrelations as well as effects need further elaboration – theoretically and empirically.

6 Conclusion

In this paper, we present the results of a structured literature review to gain understanding on how IT teams could develop ambidextrous organizational learning capability that enables them to respond efficiently to environmental changes? As to that, we argue that ambidextrous organizational learning is contingent on the IC of agile IT teams. Hence, we build up on the multilevel model which was delivered by Kang and Snell (2009). They described that firms can enhance ambidextrous learning if the several dimensions of IC are aligned.

We found much evidence for our assumption that agile IT teams need to balance exploration and exploitation in context of IC. Hitherto, we identified IC configurations that support such ambidextrous learning. The manifestations of human, social, organizational, and technological capital should be balanced within agile IT teams to make them efficient. With the help of prior literature, we identified eleven characteristics of agile IT teams that could be ordered to the IC dimensions and enable ambidextrous organizational learning. Our findings present evidences that the characteristics of agile IT teams contribute to ambidextrous learning, which is dependent on IC. The optimal setting of an agile team need to combine both types of human, social, organizational, and technological capital. Ambidextrous organizational learning can be achieved, if agile IT teams foster the simultaneous appearance of the capabilities that are necessary for exploitation and exploration.

Furthermore, we derived a new dimension namely, technological capital and determined two specificities, static and dynamic. The static form of technological capital represents organizational learning in case of exploitation and the dynamic form exploration. We contribute to prior research by synthesizing the characteristics of IC that contributes to IT teams’ ability being agile. Moreover, with the help of a literature review, we developed a research model that depicts these relationships and could guide further research. This research not only offers implication for further research, but also for practice, e.g. we show how imbalance within organizational learning could be adjusted.
References


