
Navigating Companies through the Jungle of Emerging Digital Technology Strategies

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Abstract: Between 2010 and 2020 numerous strategic approaches that deal with digital technologies including IoT, AI and Big Data emerged. These approaches contain aspects that can be associated with existing strategy schools of thought. This article analyses 84 relevant publications and identifies the prevailing strategy schools throughout these publications. Our research is based on a semi-structured literature review and a deductive coding approach. The findings show that aspects from deliberate as well as emergent strategy schools are present and combined within the analysed publications. Our insights provide executives a clear overview of the prevailing strategic schools that researchers and practitioners have drawn on. This should enable them to trace these approaches back to the fundamental thoughts of the underlying strategy schools in order to gain a more fundamental understanding of potential aspects they may want to include in their own strategy for digital technologies.

Keywords: Strategy schools of thought; Artificial Intelligence; Big Data; Internet of Things; digital strategy; digital transformation.

1 Introduction

Over the past decade numerous authors published strategic approaches that deal with emerging digital technologies in the realm of strategy making within companies. Practitioners and researchers emphasize different aspects within their strategies for digital technologies:

- “We conclude that a [digital transformation strategy] is continuously in the making, with no foreseeable end.” (Chanias, 2019, p. 1)
- “The digital strategy consists of a vision [sic], mission, strategic objectives, strategic success factors, values, and measures.” (Schallmo, 2019, p. 3)
- “You might undertake some early IoT initiatives purely to gain experience, with no expected ROI” (Olavsrud, 2017)
- “Organizations that can rapidly sense and respond to opportunities will seize the advantage in the AI-enabled landscape. So the successful strategy is to be willing to experiment and learn quickly.” (Brynjolfsson and McAfee, 2017, p. 11)

These are only a few examples of different approaches of strategy making in the digital age. How companies successfully deal with strategy making in the digital age is still not clear; for instance, nearly 80% of companies still fail to integrate their data to gain a competitive advantage (Mazzei and Noble, 2017). Lichtenthaler (2020) emphasizes that companies were not yet able to fully leverage the huge amount of data they are collecting through the vast number of connected devices in the realm of the Internet of Things (IoT). In particular, in regard to Artificial Intelligence (AI), further advancements are necessary. There are numerous publications of researchers and consultants introducing strategic approaches to address these issues. However, the strategy landscape has turned into a veritable jungle of different approaches for strategy making for digital technologies. The fundamental challenge is to bring order into this jungle and help executives to find their way through it.

Mintzberg et al. (2009, p. 381) suggest that “every strategy process has to combine various aspects of the different schools”. They further elaborate that strategists should be able to pick and choose among the ideas of the strategy schools like “diners at a buffet table” and they should also be able to “combine them into one or another palatable dish, as chefs do back in the kitchen” (Mintzberg, 2009, p. 381).

As the citations in the beginning of this section show, a community of researchers and practitioners consciously or unconsciously applied aspects from different strategy schools within their strategic approaches to address digital technologies. More transparency about which schools are applicable in which strategic contexts would allow executives to more effectively leverage digital technologies by creating a strategy that follows one or a meaningful combination of several prominent strategy schools.

Insights into these strategies can disclose patterns about the application of strategy schools to strategies for digital technologies. This may provide practitioners with a more confident choice of aspects for their own strategies. In the context of Mintzberg et al. (2009), this can be compared to the confident choice of ingredients for a dish thanks to recipes from a community that already successfully combined these ingredients into a palatable dish.

As the focus on digital technologies may vary between strategists, a combination of several aspects of different strategy schools may be necessary as well in the future. For instance, leading industrial companies like Bosch combine IoT and AI to AIoT and thereby may also require a strategy that considers both digital technologies.

Moreover, Mintzberg et al. (2009) describe that often nuances of strategic schools get lost when academic writers and consultants only include specific aspects from a school within their developed strategy. Accordingly, providing an overview where these aspects have their origin can help strategists to trace them back to the originating strategic school

and to sharpen their strategy by incorporating nuances from the strategy schools that have been lost on the way. In particular, this will benefit executives that have to take responsibility for the strategy they create for their companies (Mintzberg et al., 2009).

Based on a systematic literature review of relevant publications on strategies dealing with digital technologies between the year 2010 and 2020, this article answers the following research question: Which strategy schools can be identified in strategic approaches addressing digital technologies?

2 Theoretical Background

2.1 Digital Technologies

“Software is eating the world” (Andreessen, 2011) – the famous digital entrepreneur Marc Andreessen pictures how digital technologies are changing the business world we used to know. Since 2010 data has become a key strategic resource for companies and a reason why firms across various industries feel the pressure to digitally transform their businesses. Digital technologies such as Big Data, Internet of Things (IoT), and Artificial Intelligence (AI) support the companies to acquire, store and process the increasing amount of data (Legner, 2020). The “data-driven transformation is becoming a question of life or death in most industries” (Gourévitch et al., 2017). Thus, business leaders will be well advised to use these technologies to gain competitive advantages in a data-driven (business) world.

The **Internet of Things (IoT)** opened up a vast number of data sources through the equipment of products with sensors, data storage, microprocessors, software and connectivity components. These products are called smart connected products (Porter and Heppelmann, 2014). The application of analytics and intelligent algorithms to data generated through these devices creates new business opportunities for companies. On the one hand, it supports the innovation of new products, processes and services. On the other hand, through data sharing in data ecosystems and with third party companies, new business opportunities emerge and further value from that data can be extracted (Bilgeri, 2019; Vial, 2019). To be able to create and capture value from data, companies strategically transform their business models into data-driven business models using data as a key resource (Hartmann et al., 2016).

This data is then often further aggregated with data from other data sources (e.g. social media). In this context, the term **Big Data** is commonly used (Hartmann et al., 2016; Tabesh et al., 2019; Mazzei and Noble, 2017). Four specific features in the literature, referred to the 4Vs, characterize Big Data: volume (amount of data), velocity (increasing pace at which data is gathered and processed), variety (various types and forms) and veracity (uncertainty, e.g. potential bias in data) (Tabesh et al., 2019).

In order to fully leverage data amassed by smart connected devices, and to generate more meaningful knowledge from the vast amounts of data, **Artificial Intelligence (AI)** plays a significant role (Lichtenthaler, 2020). In turn, AI benefits from the growing amount of data. On the one hand, it leads to the improvement of existing algorithms. On the other hand, it encourages and supports the development of better ones (Brynjolfsson and McAfee, 2017).

However, there are still challenges of practical use and a lack of knowledge for using these digital technologies strategically and to create business value (Borges et al., 2020). As Hess et al (2016, p. 124) states, “A clear strategy for deploying and exploiting digital technologies is crucial for future business success”. Companies strategically address their digital initiatives and the application of digital technologies either collectively with a digital strategy, a digital transformation strategy or separately with Big Data, IoT or AI strategies.

2.2 Strategy Schools

To systematically classify strategy, it can be theoretically categorized into corporate (Ansoff, 1965) and competitive strategy (Porter, 1980). One of the most common ways to look at strategy is, however, to differentiate between the industry-based view (Porter, 1980), resource-based view (Penrose, 1959; Wernerfelt, 1984; Barney, 1991), and institution-based view (Peng et al., 2009) of strategy, which put different areas into the strategic focus.

Another one, maybe less well-known but more promising way is the distinction between different strategy schools introduced by Mintzberg et al. (2009). In fact, the proposition of ten perspectives that refer to different strategy schools of thought are more comprehensive than the view-based strategies as they are inherently part of Mintzberg et al. (2009) strategy schools. In their encyclopaedia, the authors put strategy and strategic management in vastly different perspectives and describe how strategy theory and practice has evolved over time, essentially explaining the origins of the other mentioned ways to systemize strategy. Consequently, Mintzberg et al. concepts were used for analysing digital technology strategies. In their work, Mintzberg et al. (2009) differentiate between the design, planning, positioning, entrepreneurial, cognitive, learning, power, environmental and configuration school.

Design School

In the design school, strategy is a conscious and deliberate thought process based on a “creative act” (Andrews, 1987). This process is not as formally analytical as in the planning school or positioning school, but also not as informally intuitive as the entrepreneurial school. This should enable everyone to implement the strategy. It incorporates both aspects of internal and external conditions into the strategic choices a firm decides upon. Thereby, it attempts to find a fit between internal strengths and weaknesses as well as external threats and opportunities. Only after deciding for and fully articulating one strategy, the implementation process starts and therefore suggesting a sequential order strategy and implementation. (Mintzberg et al., 2009)

Planning School

The planning school follows the premises of the design school of a sequential order of strategy formulation and execution. However, it emphasizes the planning, analysing and forecasting character during the process of finding suitable strategy alternatives that are quantitatively assessed. The execution of the strategy afterwards is highly formalized and systematically controlled. To operationalize the chosen strategy, it is further decomposed in objectives and sub-strategies with different time perspectives for the distinct entities of

the organization before the implementation process starts. Thereby, the intention is to control the operationalization of the strategy. (Mintzberg et al., 2009)

Positioning School

The beginning of the positioning school was coined by Michael E. Porter who introduced a new view of strategy in 1980. He claimed that industry structure is much more influential on a firm's strategy than the individual firm's structure. In this view, enterprises have a choice among four generic strategic options (cost leadership, differentiation, cost focus, differentiation focus) of how to compete in an industry. The emphasis of strategy lies in finding defendable positions within an environment. Also, in this school, strategy itself is formulated in a highly formalized way, using rigorous analysis to evaluate the right position. The implementation process again starts once the strategy has been formulated. (Mintzberg et al., 2009)

Entrepreneurial School

In the entrepreneurial school, strategy is about actively looking for new opportunities, constantly challenging the status quo and making big bets rather than playing small and safe games. Strategy is formulated both deliberately and emergently. On the one hand, it is deliberate as the entrepreneur has an intuitive vision of a future state for the company in his mind. On the other hand, it is emergent as the entrepreneur adapts and changes direction on the way. This creates an environment of uncertainty in which the entrepreneur thrives the most. (Mintzberg et al., 2009)

Cognitive School

The cognitive school views the formulation of strategy as a cognitive act and seeks to understand the process behind it. This school assumes that the decision-making process, irrelevant of how highly or loosely structured, falls prey to cognitive biases. As the strategy is based on individuals' knowledge and experience that is filtered individually through subjective lenses, the decision maker must understand these influences to try to neutralize them. (Mintzberg et al., 2009)

Learning School

The learning school is the first school that contradicts the separation of thinking and acting. It views strategy as a set of patterns and behaviours that emerged over time as individuals come to learn of what works and what does not. As such, strategy is best formed by launching small, low-risk experiments in which individuals quickly learn if the approach succeeds or not (Hamel, 1998). As everyone in the organisation is destined to learn and thus, contribute to strategy, the organization's role is to facilitate that learning. (Mintzberg et al., 2009)

Power School

The power school characterizes the strategy formation as a "process of influence, emphasizing the use of power and politics to negotiate strategies favorable to particular interests" (Mintzberg et al., 2009, p. 242). Internally, strategy emerges through a process

of bargaining, compromising and power plays for scarce resources. Externally, one organisation's power determines whether it needs to adjust to the environment or can make the environment fit the organization's needs. In doing so, they may exploit their networks and form strategic alliances for political rather than economic reasons. (Mintzberg et al., 2009)

Cultural School

According to the cultural school, strategy formation is the result of collectively shared set of beliefs among a group of individuals that are embedded in assumptions, intentions, patterns, beliefs, and interpretations. It is more deliberate than emergent, although not always fully conscious. It postulates that the success of strategic change is dependent on a cultural change as culture guides actions. As such, having the 'right' culture is assumed to be a competitive advantage. (Mintzberg et al., 2009)

Environmental School

Opposing the cultural school, the environmental school claims that a firm's environment is the central part in the strategy formation process. The environment is described as "everything that is not organization" (Mintzberg et al., 2009, p. 303). Strategy formation thus is about responding to the environment which is more actively done in the formation process of an organization. It tends to become more passive over time when companies merely react to changes in the environment. (Mintzberg et al., 2009)

Configuration School

The configuration school allows to incorporate the views of all schools when it seems appropriate. Essentially, strategy in this school is described as managing stability most of the time as organizations find themselves in rather stable configurations. Nevertheless, periodically organizations need to master transformative change, leaping from one configuration to another. (Mintzberg et al., 2009)

3 Methodology

To identify and analyse publications that strategically address digital technologies, a semi-structured literature review following the guidelines of Hart (1998) was selected. In addition, the underlying method is based on Webster and Watson (2002), and vom Brocke et al. (2009). In planning the research, it became apparent that a wide range of publications, from high academic and scientific standards to publications of practical wisdom from prominent management consulting companies, yielded useful insights. Consultants and executives are drivers and users of strategy and thus, strategy schools (e.g. BCG Matrix representing the positioning school). Hence, both sources were deemed as appropriate knowledge base. Consequently, the research was split into two approaches. For peer-reviewed and non-peer-reviewed research articles, the research was based on a keyword search on EBSCO Business Source Ultimate. It provides a myriad of qualitative articles from the entire business environment. For more practitioner orientated insights, a research on Google Scholar for selected consulting firms' publications was conducted. A

good indicator for defining a starting point for literature research was the research conducted by Legner et al. (2020). They point out that enterprises started seeing data as a strategic resource in 2010, to which the research time frame was set accordingly. Publications only in English were selected.

3.1 Conducting the research

Previously determined keyword strings were searched for on both EBSCO Business Source Ultimate and Google Scholar for identifying relevant and valuable research articles. The keywords were only searched for in titles and abstracts. The keyword strings used for research articles included:

- “IoT” OR “internet of things” AND “strategy”
- “digital strategy AND “digital business strategy”
- “AI” OR “artificial intelligence” AND strategy. Data strategy” OR “data strategies”
- “digital transformation strategy”

An initial test search for publications from consulting companies yielded the best results from the following firms: McKinsey & Partners, Boston Consulting Group, Deloitte, and Accenture. Consequently, the research was conducted for those companies.

3.2 Results

By adhering to the defined search guidelines, the first stage of the research yielded 4,299 articles. The title, abstract and keywords were then analysed in depth, which resulted in 327 articles. By assessing the body and content of the remaining literature and excluding those which did not have a particular strategic focus or were too industry-specific 254 further articles were excluded, which left 74 articles. Reference backtracking added another 10 articles which eventually resulted in 84 articles to be included in the review. Figure 1 provides an overview of the inclusion and exclusion of literature in the search process.

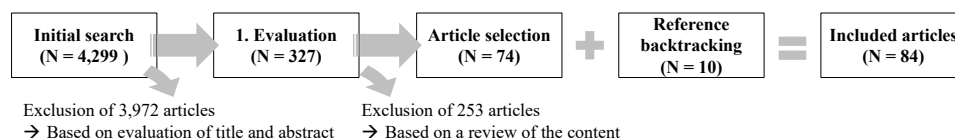


Figure 1 Inclusion and Exclusion of Literature

3.3 Analysis

After compiling the relevant literature, the publications were coded as presented by Crabtree and Miller (1999) and Linneberg and Korsgaard (2019). For deductive coding, Linneberg and Korsgaard (2019) and Crabtree and Miller (1999) propose for theory-driven study to convert existing theoretical concepts into a coding framework with usually not more than ten codes per theoretical framework. An a priori template of codes was developed by analysing Mintzberg et al. (2009) strategy encyclopaedia “Strategy Safari: The Complete Guide Through the Wilds of Strategic Management” which helped

to identify the different strategy schools of thought throughout the articles. An overview of the corresponding codes can be found in Figure 2.

Strategy schools (Mintzberg et al. 2009)	Deductive codes
1) The Design School (pp. 23-47)	<ul style="list-style-type: none"> 1.1. Focus on internal and external conditions 1.2. Strategy is formulated occasionally 1.3. Strategy within stable and predictable environments 1.4. Structure follows strategy 1.5. Strategy is tailored to individual case 1.6. Strategy formulation is simple 1.7. Generation of strategic options and deciding for one 1.8. Strategy formulation as deliberate thought process
2) The Planning School (pp. 50-83)	<ul style="list-style-type: none"> 2.1. Strategy is based on planning and forecasting 2.2. Strategy and goals are quantified 2.3. Strategy is decomposed in (sub-)objectives 2.4. Annual strategy making cycles
3) The Positioning School (pp. 86-127)	<ul style="list-style-type: none"> 3.1. Industry structure drives strategy/organisational structure 3.2. Strategy is based on rigorous calculations 3.3. Strategy is generic 3.4. Strategy is about positioning within an environment
4) The Entrepreneurial School (pp. 129-154)	<ul style="list-style-type: none"> 4.1. Strategy is about taking bold steps/embrace uncertainty 4.2. Leader (CEO, entrepreneur) dictates organisation structure 4.3. Strategy is questioning the status quo 4.4. Strategy is based on intuition and experience 4.5. Strategy is deliberate (vision) and emergent (adapting) 4.6. Strategy is a visionary image in leader's mind
5) The Cognitive School (pp. 155-184)	<ul style="list-style-type: none"> 5.1. The mind as central area for strategy formation 5.2. Environment is either distorted, interpreted or constructed 5.3. Decision-making is affected by cognitive biases and filters 5.4. Strategies are concepts to deal with inputs from environment 5.5. Strategy formation is based on knowledge of strategist
6) The Learning School (pp. 186-240)	<ul style="list-style-type: none"> 6.1. Senior Management responsible for facilitating learning 6.2. Learning through small projects (succeeding or failing) 6.3. Any individual can learn and make strategy 6.4. Strategies emerge through learning, thinking and acting 6.5. Interest of how strategies are actually formed 6.6. Long-term planning seems not attainable
7) The Power School (pp. 242-273)	<ul style="list-style-type: none"> 7.1. Individual are not always rational 7.2. Strategy is about allocation of scarce resources 7.3. Strategy as positioning and ploys 7.4. Control of internal and external environment 7.5. Individual/group/organization with power forms strategy 7.6. Strategy form emergently, prior deliberate process 7.7. Strategy formation is impacted by power mechanisms
8) The Cultural School (pp. 276-300)	<ul style="list-style-type: none"> 8.1. Strategy as patterns how resources/capabilities are used 8.2. Strategy as process of social interaction 8.3. Strategy is influenced by culture 8.4. Culture as resource of competitive advantage 8.5. Strategic change entails cultural change
9) The Environmental School (pp. 302-316)	<ul style="list-style-type: none"> 9.1. In long-term, organizations become familiar 9.2. Early decisions influential for organizations 9.3. Environment as central actor in strategy-making 9.4. Strategy is about responding to environment
10) The Configuration School (pp. 318-361)	<ul style="list-style-type: none"> 10.1. Strategy is about occasional quantum leaps 10.2. Strategy is about jumping from one state to another 10.3. Strategy is about marginally adapting strategic direction 10.4. Organisations are found in rather stable configurations 10.5. Strategy as configuration of capabilities and resources

Figure 2 Deductive codes for strategy schools of thought

4 Findings

The study of the articles revealed that specifically five different strategy schools could be identified in the publications that addressed the emerging strategies. The articles followed either one or multiple strategy schools. Among the 84 articles, 43% followed the learning school. Furthermore, articles were shaped by the entrepreneurial school (38%), cultural school (38%), positioning school (36%), and design school (33%).

For **AI strategy**, it could be observed that the entrepreneurial, positioning, learning, and cultural school are strategic schools that shape current strategic approaches for AI (see Table 1). Davenport and Mahidar (2018) and Ransbotham et al. (2019) consider aspects of the entrepreneurial and positioning school: Know-how and capabilities in the novel field of artificial intelligence still need to be built up, but a company cannot wait until the knowledge base is ready, they rather need to shoot ahead and proactively seek the risk to start early initiatives with an entrepreneurial manner. “Rather, Pioneers focus on projects with the potential for transformative impact — and they accept that doing so entails greater uncertainty than less transformative projects.” (Ransbotham et al., 2019, p. 11). AI is deemed to not only affect individual businesses but entire industries as competitors and particularly tech-centric behemoths will eventually adopt the technology and build business models around it. Following the positioning school, companies need to build up cognitive capabilities and position them wisely against the competition: “Companies should expect their established competitors to eventually adopt cognitive technologies, and be aware that many are doing so now. However, a bigger threat may come from tech-centric players who aren’t afraid to develop business models around technology.” (Davenport, 2018, p. 23).

Lichtenthaler (2020) also draws on the learning and cultural school. He emphasizes on the one hand the importance of learning through small projects, by succeeding or failing: “There is a necessary experimentation period in achieving an intelligence-based competitive advantage” (Lichtenthaler, 2020, p. 25). On the other hand, he points out that the organizational culture is one of the aspects that needs to be considered when preparing companies to leverage AI (Lichtenthaler, 2020).

Table 1 Code appearance - AI Strategy

<i>Schools</i>	<i>Documents</i>	<i>Author(s)</i>
Design School	4	Davenport and Mahidar (2018), Lauterbach and Bonime-Blanc (2016), Baan and Chang (2018), Ransbotham et al. (2019)
Planning School	4	Baan and Chang (2018), Kiron and Schrage (2019), Plastino and Purdy (2018), Davenport and Mahidar (2018)
Positioning School	9	Agrawal et al. (2017), Baan and Chang (2018), Batra et al. (2018), Davenport and Mahidar (2018), Iansiti and Lakhani (2020), Lauterbach and Bonime-Blanc (2016), Namaki (2018), Ransbotham et al. (2019), Bordonaro (2018)
Entrepreneurial School	10	Davenport and Mahidar (2018), Kolbjornsrud et al. (2016), Ransbotham et al. (2019)Batra et al. (2018), Iansiti and Lakhani (2020), Alvero and Cassels (2020),

		Baan and Chang (2018), Lichtenthaler (2020), Gerbert et al. (2017), Bordonaro (2018)
Cognitive School	4	Alvero and Cassels (2020), Iansiti and Lakhani (2020), Kolbjornsrud et al. (2016), Lauterbach and Bonime-Blanc (2016)
Learning School	7	Davenport and Mahidar (2018), Gerbert et al. (2017), Kolbjornsrud et al. (2016), Lichtenthaler (2020), Ransbotham et al. (2019), Plastino and Purdy (2018), Bordonaro (2018)
Power School	4	Alvero and Cassels (2020), Iansiti and Lakhani (2020), Davenport and Mahidar (2018), Bordonaro (2018)
Cultural School	8	Baan and Chang (2018), Bordonaro (2018), Davenport and Mahidar (2018), Lichtenthaler (2020), Namaki (2018), Plastino and Purdy (2018), Ransbotham et al. (2019), Alvero and Cassels (2020),
Environmental School	5	Baan and Chang (2018), Batra et al. (2018), Iansiti and Lakhani (2020), Agrawal et al. (2017), Ransbotham et al. (2019)
Configuration School	3	Batra et al. (2018), Davenport and Mahidar (2018), Ransbotham et al. (2019)
Analysed documents	15	

As Table 2 shows, for an **IoT strategy**, the positioning and learning school could be identified as most prominent schools. With their publication, Porter and Heppelmann (2014) shaped strategy making for IoT devices strongly. Porter (1980) was one of the main contributors to the positioning school. Major aspects of this school like the competitive forces can be also identified in Porter and Heppelmann (2014, p. 10), “To understand the effects of smart, connected products on industry competition and profitability, we must examine their impact on industry structure. In any industry, competition is driven by five competitive forces.” IoT strategies that follow the learning school introduce a rather use-case based approach. Value from IoT can be best obtained by starting IoT initiatives, learning, and adopting them on a broader scale once they prove valuable (Chui et al., 2018; Custeau, 2019; Olavsrud, 2017; Symons, 2016).

Table 2 Code appearance - IoT Strategy

<i>Schools</i>	<i>Documents</i>	<i>Author(s)</i>
Design School	2	Müller et al. (2018), Olavsrud (2017)
Planning School	2	Symons (2016), Müller et al. (2018)
Positioning School	4	Müller et al. (2018), Olavsrud (2017), Porter and Heppelmann (2014), Gerpott and May (2016),
Entrepreneurial School	1	Müller et al. (2018)
Cognitive School	0	
Learning School	5	Chui et al. (2018), Custeau (2019), Müller et al. (2018), Olavsrud (2017), Symons (2016)

Power School	1	Symons (2016)
Cultural School	2	Müller et al. (2018), Symons (2016)
Environmental School	0	
Configuration School	0	
Analysed documents	10	

The research showed that **data strategies** are primarily rooted in the strategy schools that favour a deliberate strategy, particularly shaped by the design and planning school (see Table 3). As proposed by the design school, executives evaluate the status-quo, define a future desired state, then generate alternative strategies, and decide for the option with the most promising outcome. Decisions are then evaluated and fed back to the initial challenge (Tabesh et al., 2019). Nevertheless, Tabesh et al. (2019, p. 352) among other researchers, are certain: “The lack of data-driven culture is among the major reasons for the high failure rate of big data projects”, emphasizing the importance of the cultural school. Moreover, major aspects of the learning school influence data strategies strongly. For instance, Mazzei and Nobble (2017) describes data-driven initiatives of leading tech companies as a strategic capacity for learning: While Facebook invests into virtual reality, Alphabet is investing into self-driving cars.

Table 3 Code appearance - Data Strategy

<i>Schools</i>	<i>Documents</i>	<i>Author(s)</i>
Design School	10	Bughin et al. (2011), Davenport and Redman (2020), Dewitt et al. (n.d.), Hassan and Chindamo (2017), Redman (2018), Wilson (2015), Harris and Craig (2017), Majeed et al. (2017), Tabesh et al. (2019), Parise et al. (2012)
Planning School	6	Bughin et al. (2011), Dewitt et al. (n.d.), Hassan and Chindamo (2017), Harris and Craig (2017), Tabesh et al. (2019), Wilson (2015)
Positioning School	5	Harris and Craig (2017), Mazzei and Noble (2017), Parise et al. (2012), DalleMulle and Davenport (2017), Diaz et al. (2018)
Entrepreneurial School	5	Dewitt et al. (n.d.), Hassan and Chindamo (2017), Mazzei and Noble (2017), Tabesh et al. (2019), Diaz et al. (2018)
Cognitive School	0	
Learning School	7	Diaz et al. (2018), Majeed et al. (2017), Souza et al. (2013), Wilson (2015), Harris and Craig (2017), Redman (2018), Mazzei and Noble (2017)
Power School	3	DalleMulle and Davenport (2017) Tabesh et al. (2019), Hassan and Chindamo (2017)
Cultural School	8	Bughin et al. (2011), Chetan and Aaabid (2020), DalleMulle and Davenport (2017), Diaz et al. (2018), Redman (2018), Tabesh et al. (2019), Dewitt et al. (n.d.), Wilson (2015)

Environmental School	3	Bughin et al. (2011), DalleMulle and Davenport (2017), Mazzei and Noble (2017)
Configuration School	2	DalleMulle and Davenport (2017), Mazzei and Noble (2017)
Analysed documents	15	

Within the investigated publications that focus on **digital transformation strategies**, aspects of the entrepreneurial, the learning and the environmental school could be identified. Table 4 shows the results.

In the context of the entrepreneurial school, according to Dahlström et al. (2017), McGrath and McManus (2020), Pierenkemper and Gausemeier (2020) digital transformation strategies are initiated by a deliberate thought, in the form of a vision, which is then, however, absorbed by emergent strategy making (Chanas et al., 2019). Emergent strategy making is a central aspect of learning. Learning is in particular driven by the incorporation of insights from small digital transformation projects and quick wins and may require an adaptation of the strategy (Chanas et al., 2019; Matt et al., 2015; Bryan, 2019). Learnings help to quickly understand what works and what new business models could be introduced (Chanas et al., 2019).

Environmental aspects are considered by Dahlström et al. (2017) and Pierenkemper and Gausemeier (2020) in such that they prescribe a thorough analysis of economical and socio-economical environment in which digital technologies tend to be an influential and changing factor.

Table 4 Code appearance - Digital Transformation Strategy

<i>Schools</i>	<i>Documents</i>	<i>Author(s)</i>
Design School	2	Pierenkemper and Gausemeier (2020), Sebastian et al. (2017)
Planning School	2	Pierenkemper and Gausemeier (2020), Sebastian et al. (2017)
Positioning School	2	Dahlström et al. (2017), Tekic and Koroteev (2019)
Entrepreneurial School	4	Dahlström et al. (2017), McGrath and McManus (2020), Pierenkemper and Gausemeier (2020), Chanas et al. (2019)
Cognitive School	0	
Learning School	6	Bryan (2019), Chanas et al. (2019), McGrath and McManus (2020), Vial (2019), Wang et al. (2020), Matt et al. (2015)
Power School	1	Dahlström et al. (2017)
Cultural School	3	Bryan (2019), Chanas et al. (2019), Vial (2019)
Environmental School	4	Dahlström et al. (2017), Hess et al. (2016), Pierenkemper and Gausemeier (2020), Sebastian et al. (2017)
Configuration School	0	
Analysed documents	14	

As Table 5 shows, **digital (business) strategies** have been vastly researched from different perspectives, as nearly all strategic schools of thought are frequently represented. Similar to the number of relevant publications, the variety of aspects considered from different schools is broader. The research shows that a digital strategy has both deliberate and emergent characteristics. Between the most influential schools, the entrepreneurial, cultural, environmental and positioning school stood out.

As a central aspect of the entrepreneurial school, the vision as a bold step is also central to Kane et al. (2015), Bughin and Van Zeebroeck (2017), Catlin et al., (2015), and Butner (2019) as they not only show that a mental image helps to get the whole organization on board, but also helps to fend off new competitors that enter the market with a tech enabled business model. It is about being bold and aggressive: “For companies looking to successfully ward off digital disruption, they have to play offense.” (Bughin and Van Zeebroeck, 2017, p. 4).

In the context of the cultural school, taking deliberate risky choices also encourages employees to be bold (Kane et al., 2015) and to embrace change (Daub and Wiesinger, 2015) rather than to fear it. Gobble (2018), Daub and Wiesinger (2015), and Kane et al. (2015) are certain that the successful adoption of transformative technologies is spearheaded by a culture of innovation and risk-taking. Hemerling et al. (2018) proved in their study that the financial performance was five times higher at companies adopting new technologies that focused on culture than those companies that neglected it.

Through the lens of the environmental and positing school, a focus is laid on ecosystems, alliances, partnerships and competitors that are intertwined with a firm’s strategy (Bharadwaj et al., 2013). Butner (2019) found that 96% of digitally successful companies can effectively respond to market changes. This is also shown by Mithas et al. (2013).

For digital (business) strategy as a more deliberate strategy, Schallmo et al. (2019) provide a profound understanding. For the more emergent corner, particularly Kane et al. (2015, 2016) are exemplary.

Table 5 Code appearance - Digital Strategy

<i>Schools</i>	<i>Documents</i>	<i>Author(s)</i>
Design School	9	Bughin et al. (2019), Mithas et al. (2013), Platt et al. (2014), Schallmo et al. (2019), MacKenzie and Alpern (2017), Park and Mithas (2020), Ross et al. (2017), Platt et al. (2014), Daub and Wiesinger (2015)
Planning School	3	Kane et al. (2016), Schallmo et al. (2019), Butner (2019),
Positioning School	10	Bughin and Van Zeebroeck (2017), Butner (2019), Ikeda and Marshall (2019), Jin et al. (2020), Ross et al. (2017), Schallmo et al. (2019), Bughin et al. (2017), Catlin et al. (2015), Mithas et al. (2013), Pagani (2013)
Entrepreneurial School	11	Bailey et al. (2019), Butner (2019), Gobble (2018), Kane et al. (2016), Ross et al. (2016), Schallmo et al. (2019), Westerman (2017), Bughin et al. (2017), Bughin and Van Zeebroeck (2017), Catlin et al. (2015), Kane et al. (2015)

Cognitive School	0	
Learning School	9	Bailey et al. (2019), Bughin et al. (2017), Butner (2019), Catlin et al. (2015), Daub and Wiesinger (2015), Hemerling et al. (2018), Kane et al. (2015), Kane et al. (2016), MacKenzie and Alpern (2017)
Power School	3	Posner (2017), Grover and Kohli (2013), Samuels (2019)
Cultural School	13	Butner (2019), Daub and Wiesinger (2015), Gobble (2018), Hemerling et al. (2018), Kane et al. (2015), MacKenzie and Alpern (2017), Ross et al. (2016), Samuels (2019), Bughin et al. (2017), Bughin et al. (2019), Catlin et al. (2015), Kane et al. (2016), Cameron (2015)
Environmental School	10	Bharadwaj et al. (2013), Bughin et al. (2019), Gobble (2018), Hemerling et al. (2018), Mithas et al. (2013), Park and Mithas (2020), Schallmo et al. (2019), Butner (2019), Kane et al. (2015), Ross et al. (2016)
Configuration School	2	Westerman (2017), Park and Mithas (2020)
Analysed documents	30	

5 Conclusion

As Table 6 illustrates, there are five strategy schools that shape strategic approaches in the digital age the most. These schools are either deliberate (design, positioning, cultural), emergent (learning) or combine both characteristics (entrepreneurial).

Table 6 Code overview

<i>Schools</i>	<i>Total</i>	<i>AI Strategy</i>	<i>IoT Strategy</i>	<i>Data Strategy</i>	<i>Digital (Business) Strategy</i>	<i>Digital Transformation Strategy</i>
Design School	33%	27%	20%	67%	30%	14%
Planning School	21%	27%	20%	40%	10%	14%
Positioning School	36%	60%	40%	33%	33%	14%
Entrepreneurial School	38%	67%	10%	33%	37%	29%
Cognitive School	5%	27%	0%	0%	0%	0%
Learning School	43%	47%	50%	47%	30%	43%
Power School	14%	27%	10%	20%	10%	7%
Cultural School	38%	47%	20%	47%	43%	21%
Environmental School	26%	33%	0%	20%	33%	29%
Configuration School	10%	20%	0%	13%	7%	0%
Number of analysed documents	84	15	10	15	30	14

Note: The percentage gives the share of documents that include aspect of a certain strategy school. One document can include aspects from several schools.

Among those five predominant strategy schools, particularly the learning school was mentioned most frequently in the literature. This is not surprising as companies undergoing digital change cannot rely on existing experience in leveraging data (Gourévitch et al, 2017; Ransbotham et al., 2019). Building up experiences and capabilities is often achieved through fast and small projects. Further, what the digital technology strategies also have in common is a certain perspective of risk. As businesses are operating in a continuously fast-changing environment with often limited experience, firms have no other choice than to take some sort of risk to avoid falling behind competition (DalleMulle and Davenport, 2017). This perspective of risk is both incorporated in the entrepreneurial and cultural school. On the entrepreneurial side, it is the very nature that assuming risks lead to innovation and successful adoption of digital technologies. On the cultural side, without a working environment that not only enables but promotes taking calculated risks and allows failures to occur, organizations cannot effectively deal with opportunities that come with the use of new digital technologies.

A higher focus on deliberate choices and conception as represented by the design, positioning and cultural school could be observed in particular for digital (business) strategy. The literature research revealed that this strategy is the most encompassing of all digital technology strategies, thus incorporating many aspects that need to be thought through well in the first place.

Summarizing, our research raises awareness to the fact that emerging strategies that leverage digital technologies include aspects that can be assigned to individual strategy schools. So far, it was not clear which schools are prevailing in the digital age and which aspects in emerging digital technology strategies actually stem from these concepts. Five main strategy schools of thought were identified to which most of the aspects of these strategies can be traced back to. Based on the quantitative evaluation, managers can directly identify which schools of thought are relevant in their own strategy development process. It may allow them to confidently choose among aspects from specific strategy schools for their own strategy for digital technologies. Furthermore, with the findings presented in this paper, executives will be able to better understand the origin of aspects within existing strategic approaches. By revisiting the origin of these aspects, further contextual knowledge can be generated and lost nuances recovered. Executives may be able to leverage this knowledge in their company's strategy making process and navigate their companies through the jungle of emerging digital technology strategies.

7 Limitations and Recommendations for Further Research

The aim of this paper was to identify strategy schools formulated by Mintzberg et al. (2009) in emerging strategic approach to digital technologies through deductive coding. First, coding naturally involves the risk that researchers would code and categorize differently, which may lead to different outcomes. Second, the abstraction of Mintzberg et al. strategy encyclopaedia into deductive codes inherits the risk of losing information on the way. Third, the current analysis is based on a coding approach that identifies prevailing strategy schools based on a quantitative measure. However, despite their rarity underrepresented schools (power, cognitive, configuration) may also provide promising aspects to strategically address digital technologies. Lastly, although the process of gathering the literature was initially defined and thus guarantees consistency in the

method, it cannot be completely guaranteed that potentially valuable literature was not considered in the literature review.

Nevertheless, there are relevant areas of interest for future research that may build on our study results and may overcome existing limitations. First, it would be interesting to observe whether industries have an impact of the applicability of inherent strategy schools within strategic approaches. Second, a more extensive coding approach with two coders could be conducted to ensure more reliability within the coding. Third, in a study following the same methodology, further digital technologies than those incorporated in the research could be included. Consequently, researching strategic approaches that address further emerging technologies (e.g., 5G, blockchain) would contribute to the understanding of the applicability of strategy schools. Ultimately, technological issues emergently converge with sociological issues like ethics and trust. On the one hand, the notion of digital trust incorporates digital technologies as Big Data, AI and IoT. On the other hand, it deals with sociological issues such as trust, ethics and privacy. Hereby, aspects from so far less dominant strategic schools in the digital age may become more relevant. Hence, future strategy research may build on our insights and explicitly identify relevant strategy schools and related aspects from the very beginning when such strategies are made. For instance, the power school may contribute with political aspects to strategies that address digital trust. These aspects may shape strategy in regard to power relationships within strategic alliances and digital ecosystems.

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