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RESEARCH ARTICLE

Linking information systems and entrepreneurship: A review and agenda for IT-associated and digital entrepreneurship research

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Abstract

More than 50 years ago, information technology (IT) began to change society, the economy, and industries worldwide. This change has included waves of technological disruption that have been exploited by entrepreneurial actors who seize the associated new opportunities. Research on related phenomena is spread across different disciplines. Recently, there have been calls for further research on the marriage of information systems (IS) and entrepreneurship. We review 292 articles in the IS, entrepreneurship, and general and strategic management literature to create an overview of the IT-associated entrepreneurship research landscape. On the basis of that review, we elaborate on the different roles that IT can assume to support entrepreneurial operations and value creation in these settings. Our findings suggest that IT plays four major roles in entrepreneurial operations: as a *facilitator*, making the operations of start-ups easier; as a *mediator* for new ventures' operations; as an *outcome* of entrepreneurial operations; and as a *ubiquity*, becoming the business model itself. Leveraging these roles of IT, we develop a set of definitions to clear up definition uncertainties surrounding IT-associated new ventures such as digital start-ups and digital business models. We also outline a research agenda for IT-associated entrepreneurship research based on identified roles, types, and gaps.

KEYWORDS

business model, digital entrepreneurship, entrepreneurship, information technology, review, start-up

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1 | INTRODUCTION

Waves of technological change, as well as disruptive phenomena such as information technology (IT), create a plethora of new opportunities (Kondratieff & Stolper, 1935). However, these emerging technologies do not necessarily create economic value themselves; rather, they need to be leveraged and exploited. Entrepreneurs are at the forefront as change-agents, working on the discovery, evaluation, and exploitation of new opportunities brought about by evolving technologies such as blockchain, big data, artificial intelligence, virtual/augmented reality, 3D printing, or cloud computing (Beck, Avital, Rossi, & Thatcher, 2017; Lyytinen & Rose, 2003). Still, entrepreneurs often face severe challenges in creating and capturing economic value from innovations for their stakeholders. These challenges occur due to the new and economically unexplored value dimensions that are associated with innovations (Keen & Williams, 2013). An example of such a struggle is Twitter, which faced obstacles in its attempts to find a viable business logic for years (Chesbrough & Rosenbloom, 2002; Mangalindan, 2010).

The entrepreneur's main tool for approaching these challenges is the business model, as it brings together economic (ie, value creation and capture) and technological perspectives of innovations and enables trial-and-error learning (Al-Debei & Avison, 2010; Hedman & Kalling, 2003; Sosna, Trevinyo-Rodríguez, & Velamuri, 2010; Veit et al., 2014). Hence, entrepreneurs design, experiment with, and implement new business models. This is regularly done by absorbing technology (ie, IT) into the business model of a new venture (eg, as a resource or a product) (Chesbrough & Rosenbloom, 2002; Fiet & Patel, 2008; George & Bock, 2011). Many recent business models pursued by entrepreneurs are, in their entirety, only possible through the enabling function of IT (Rai & Tang, 2014); for others, IT offers avenues for financing (Belleflamme, Lambert, & Schwienbacher, 2014; Gleasure, 2015; Mollick, 2014; Preston, 2018).

However, taking into account these major impacts of IT on entrepreneurship, research in this area is still sparse—and dispersed across different disciplines. Definitions of the associated phenomena (eg, digital business models and digital start-ups) are also vague or non-existent. However, it is argued in the literature that "[g]ood science has to start with good definitions" (Bygrave & Hofer, 1991, p. 13) to enable targeted inquiry, operationalizations, and generalizations (Nag, Hambrick, & Chen, 2007).

Furthermore, and closely linked, understanding the different types of new ventures and business models in the field is fundamental for advancing research (Kantor, 1953; Kemeny, 1959). This understanding is considered particularly important in young fields, as emphasized by Wolf (1926), who stated that the verification of the laws of science and explanatory inquiry can only succeed after classification has been completed. Classification schemes allow scholars to delimit and generalize their work and theories to certain classes (ie, types of technologies or firms) (Bailey, 1994; Lambert, 2015; Nickerson, Varshney, & Muntermann, 2013). Recent debates in information systems (IS) (eg, Sarker, 2016) as well as in entrepreneurship (eg, Zahra, 2007) have raised the awareness of contextualization in research, which is only to be reached through further distinction of institutions and their particularities (Davison & Martinsons, 2016). A classification scheme for IT-associated start-ups should henceforth take into account contextual specifics and disentangle different types of ventures of this domain. This is important because new ventures not only are fundamentally different from established firms as argued by the liability of newness concept (Stinchcombe, 1965) but they also have much higher uncertainties in their quest for viable business logic when it comes to their product or organizational development that might be strongly influenced by IT on different levels. The business model is a concept that integrates these technological and organizational levels and thereby can serve as an instrument for classification (Osterwalder, Pigneur, & Tucci, 2005).

Several classification schemes exist in the business model literature (eg, for electronic markets, Timmers, 1998; telemedicine, Peters, Blohm, & Leimeister, 2015; or e-government, Janssen & Kuk, 2007) and are mostly seen as lacking clear criteria or scope (Lambert, 2015). These schemes are targeting various niches, but none of them accounts for new ventures in conjunction with the role of IT. Hence, we develop definitions and a classification scheme for IT-associated start-ups by leveraging the business model concept. We thereby try to take into account the particularities of IT and new ventures at the same time to delineate the field. A clear understanding of the definitions and types of

IT-associated new ventures will allow future research to better tailor theoretical perspectives and methods to particular contexts. To the best of our knowledge, these contextual differences have been mostly ignored in existing research, potentially triggering side effects. For instance, if an analysis is run on a sample that includes firms of types 1 and 2, their differing IT usage patterns might cancel out firm performance effects.

Additionally, recent articles have expressed the need to further elaborate on IT-associated entrepreneurship in the IS discipline (eg, Clemons, Hedman, Sarker, & Veit, 2013; Del Giudice & Straub, 2011; Fichman, Dos Santos, & Zheng, 2014; Veit et al., 2014) as well as in entrepreneurship and management (Kiss, Danis, & Cavusgil, 2012; Matlay, 2005; Nambisan, 2017; Shepherd, Williams, & Patzelt, 2015). We answer these calls by reviewing 292 articles in these disciplines with three objectives:

1. We aim to provide an overview and categorization of existing IT-associated entrepreneurship research, together with insights on the use of the business model concept. This is intended as a foundation for future work in the field.
2. We offer a comprehensive set of definitions based on patterns of the field, thus clearing up definition uncertainty regarding IT-associated entrepreneurial ventures and related business models. We thereby distinguish different types of ventures based on IT's role to enable more nuanced and generalizable research.
3. We highlight themes and gaps in the literature and suggest avenues for IT-associated entrepreneurship research to inspire future research.

2 | RESEARCH METHOD

2.1 | Review approach

To achieve the introduced objectives, we use a systematic literature review approach by applying the suggestions of Webster and Watson (2002) and following the process of Xiao, Califf, Sarker, and Sarker (2013). The steps of the process are outlined in Table 1. We use a systematic approach because we wanted to clearly address the three disciplines: IS, entrepreneurship, and general and strategic management (GSM).

TABLE 1 Steps of the review approach (adapted from Xiao et al., 2013)

Step	Description
1. Selection of journals	We selected 18 relevant journals matching our interdisciplinary topic.
2. Identification of articles	We initially identified 2389 potentially relevant articles from these journals using carefully crafted keywords and shortlisted results through manual screening. After this screening, the shortlist contained 268 articles. We analysed all shortlisted articles' bibliographies for additional contributions matching our topic, and we manually reviewed the identified potential candidates. All candidates deemed relevant (24) during this step were added to our shortlist, producing the final sample of 292 articles.
3. Review and categorization of articles	We reviewed and categorized the articles in the final sample using a concept matrix via their level of IT use in their business models; here, we leveraged the components of Osterwalder et al. (2005). Additionally, frameworks such as Benbasat and Weber's (1996) framework of research diversity in IS, with problems, theoretical foundations, and methods, as well as Gregor's (2006) theory types, were used. We also applied iterative induction to develop new categories from the reviewed articles (Wolfswinkel, Furtmueller, & Wilderom, 2011; Xiao et al., 2013). This was, for example, done for the application of the business model concept by researchers in the reviewed articles.
4. Analysis of results	We analyse and calculate numbers of articles for categories and subcategories.
5. Presentation of results and agenda	We present the identified results and gaps on different levels, based on the business model concept, and we develop an agenda for future research.

Abbreviations: IS, information systems; IT, information technology.

The systematic approach also allows us to find patterns and create comparisons between the disciplines. Such reviews are common (eg, Bélanger & Crossler, 2011; Connelly, Certo, Ireland, & Reutzel, 2011; Smith, Dinev, & Xu, 2011) in these disciplines. Because the chosen topic is interdisciplinary in nature, we selected the eight journals from the "IS Senior Scholars Basket" to cover the IS discipline. We added the four most-important entrepreneurship journals and also included the six highest-impact journals that are known to publish most entrepreneurship articles in the GSM discipline (Ireland & Webb, 2007; Shane, 1997). An overview of selected journals is given in Table 2. After manual screening for relevance, our final sample contains 292 articles (for details of the search and article selection process, see Appendix A).

2.2 | Review and analytical framework for article categorization

We carefully reviewed and classified all 292 articles in the final sample. Classification was performed by two independent reviewers using inductive and deductive reasoning (Xiao et al., 2013). Our review analysis approach was rather interpretive in nature, allowing us to interpret and build abstractions from our results (Noblit & Hare, 1988). Such review analyses "see the essential tasks of synthesis as involving both induction and interpretation. Their primary concern is with the development of concepts" (Dixon-Woods et al., 2006, p. 2).

We developed an analytical review framework consisting of both elements specific to our objectives (eg, levels of IT use in the business model) and established elements (eg, theories and research methods used) of reviews. Review frameworks generally support the description of objects within a specific domain and are particularly helpful in young fields in that they help to define and describe related knowledge (Dibbern, Goles, Hirschheim, & Jayatilaka, 2004). Our analytical framework describes the domain of IT-associated entrepreneurship research from a business model perspective, and the elements of our framework are briefly explained in the following.

2.2.1 | Business models and their levels of IT use in entrepreneurial ventures

Foundations of business models

Business models are seen as a perspective from which to understand technological change and opportunity-seeking from the business value side. The main focus of business models is on value creation and transaction for stakeholders involved in venture-seizing opportunities (Osterwalder et al., 2005; Zott, Amit, & Massa, 2011). Hence, they are defined as depicting "the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities" (Amit & Zott, 2001, p. 511). Business models are researched regularly in both the IS (Veit et al., 2014) and entrepreneurship disciplines (George & Bock, 2011; Morris, Schindehutte, & Allen, 2005).

Functions of business models

The business model has two main functions: (1) Every venture has some a "real" business model that depicts its business logic either implicitly or explicitly and (2) the business model is also used as a tool by researchers to analyse,

TABLE 2 Journals included in the review (adapted from Ireland & Webb, 2007; Shane, 1997; Xiao et al., 2013)

Information Systems	Entrepreneurship	General/Strategic Management
• *European Journal of Information Systems* • *Information Systems Journal* • *Information Systems Research* • *Journal of Information Technology* • *Journal of Management Information Systems* • *Journal of Strategic Information Systems* • *Journal of the AIS* • *MIS Quarterly*	• *Entrepreneurship: Theory and Practice* • *Journal of Business Venturing* • *Research Policy* • *Strategic Entrepreneurship Journal*	• *Academy of Management Journal* • *Administrative Science Quarterly* • *Journal of Management* • *Management Science* • *Organization Science* • *Strategic Management Journal*

describe, and classify businesses (Baden-Fuller & Morgan, 2010). In this paper, we refer to the former use as the "real" business model and to the latter as the "business model concept" in the following.

Components of business models

For further clarification, we want to briefly highlight a substream of research: Research has generated various *components* (often also called pillars) of business models, such as the *value proposition*, the *distribution channel*, and the *revenue model* (Osterwalder et al., 2005; Osterwalder & Pigneur, 2010). In our review, we leveraged one of the most-cited works on the pillars of business models, namely, that of Osterwalder et al. (2005), who suggest that business models broadly consist of three main pillars (besides financial aspects): *product*, *customer interface*, and *infrastructure management*.

First, the *product* pillar describes the value proposition of a firm through the "bundle of products and services" (Osterwalder et al., 2005, p. 18) offered. Second, the *customer interface* pillar depicts the distribution channels, types, and ways in which a firm establishes links to its customers. Third, the *infrastructure management* pillar mainly focuses on the infrastructure resources and activities that a firm arranges to create value and run its business model efficiently (Osterwalder et al., 2005).

Levels of IT use in business models

We used these three dimensions to classify levels of IT use in the "real" business models of the study samples and case firms in the reviewed articles. We therefore reviewed and coded all parts of the articles where details and contexts of the sample or case firms were mentioned. Of course, these codes do rely on the information provided by the authors of the articles and on their descriptions of the analysed firms. If not enough details were explicitly stated, there was "some degree of interpretation on our part" (Dibbern et al., 2004, p. 25) involved. To keep this as low as possible, two coders discussed ambiguous articles and information (Strong & Volkoff, 2010). One such instance is the article by Whitley (1999), who analyses participation in the systems development process of a food start-up. Here, only the use of IT in the infrastructure management part of the business model was coded in the article. In another example article (Rothaermel & Sugiyama, 2001) on virtual communities, we coded the use of IT for the infrastructure management part, the customer interface, and the product/service pillars. We further developed abstractions of the patterns and connected them in subsequent steps (Wolfswinkel et al., 2011). It is a common practice in the IS discipline to apply the business model concept and its dimensions when analysing IT use in firms (eg, Hedman & Kalling, 2003).

Business model transition and evolution

Entrepreneurs constantly try to identify and seize new opportunities created by societal, environmental, and technological changes (Short, Ketchen, Shook, & Ireland, 2010). In search of viable business logic, new ventures oftentimes undergo many transitions of their activities and value configurations because value creation and capture logics are mostly unknown when entrepreneurs are pursuing newly created products, services, or markets. However, any "business is fundamentally concerned with creating value and capturing returns from that value" (Shafer, Smith, & Linder, 2005, p. 202), which is seen as one of the main factors in understanding the success or failure of firms (Porter, 1985). This concerns value derived for all parties (eg, customers, firm, shareholders, or suppliers) who are directly or indirectly affiliated with the business' transactions (Zott, Amit, & Donlevy, 2000). Porter (1985) explains value creation and capture through the activities of firms, thereby distinguishing between primary and supporting activities. Primary activities such as production or sales are directly involved in value creation and capture through a product or service, while supporting activities (eg, infrastructure) only contribute indirectly by enhancing the performance of primary activities (Amit & Zott, 2001; Porter, 1985).

Business models further integrate these thoughts as activity systems that define value creation and capture through the configuration of activities, their linkages, and dynamics (Afuah & Tucci, 2000; Zott & Amit, 2010). Hence, entrepreneurs use trial-and-error learning to experiment with and search for business models that allow value

creation and capture from new opportunities in a sustainable way (Sosna et al., 2010). This type of learning involves frequent business model transitions (also called business model transformation, evolution, or innovation). Such transformations often require radical reconfiguration of the entire organization and its value chain, including primary and supporting activities (Zott & Amit, 2017).

Business model transitions can thereby impact one or more of the three design elements. First, *content* might be reconfigured, which means that the performed set of activities is changed. Second, changes can be made to the logic of how activities are linked and sequenced, changing the *structure* of the business model. Third, changes in *governance* impact who performs specific activities (Zott & Amit, 2010). Hence, when managing this process, entrepreneurs face continuous resource-intensive challenges, and available resources are usually scarce (Baker & Nelson, 2005). Most newly created ventures therefore are confronted with the danger of failing during this search because they cannot establish strong enough value creation and capture configurations; this is particularly true for IT-associated start-ups (Hathaway, 2013; Singh, Corner, & Pavlovich, 2007; Timmons, 1994). This fact, together with the entrepreneurial mindset of constantly seeking new opportunities and being inspired by trends such as the blockchain, augmented/virtual reality, bots, Internet of Things, big data analytics, and artificial intelligence, leads to even more and faster screening and adoption of new technologies into the business model; such behaviour is part of the quest to find a viable business model before a venture runs out of resources (Lal, 1999).

Research has established four typical business model configuration patterns of the three business model design elements (content, structure, and governance). These patterns detail the dominant value creation or value enhancing drivers in general and can support the abovementioned quest. First, a *novelty* orientation focuses on a configuration that supports constant innovation of new contents, structures, and governance to drive value creation. Second, supporting value creation by orchestrating the three design elements for customer *lock-in*, via network externalities or switching costs, is also a common pattern. Third, bundling activities in such a way that *complementarities* dominate value creation was also found to be widespread; one example is the enhancement of marketplaces with specialized payment mechanisms. Fourth, configuring the three design elements to mainly focus on cost savings is the common *efficiency*-focused value-driving pattern (Zott & Amit, 2010; Zott & Amit, 2017).

2.2.2 | Application of the business model concept in IT-associated entrepreneurship research

A business model can be the existing business logic of a real venture or a tool for scientific inquiry (Baden-Fuller & Morgan, 2010). In contrast to the discussion above, we now explain our analysis of the scientific use of the business model concept by the scholars crafting the reviewed articles. To do so, we inductively derived the type of application of the business model concept for each article. This was done by completely searching the full-texts of all 292 articles for the term "business model," because the business model concept is seen as being closely linked with entrepreneurial topics, and we were curious whether and how the concept was used by the authors. If the term "business model" was found, we further coded and analysed how the business model concept was used by the authors of the specific article. This was done in iterative steps, using induction to let the categories emerge from the type of use in the articles. We thereby created open codes, excerpts, and memos of the business model concept as used by the authors and read all relevant parts of the article. For instance, in the work of Doganova and Eyquem-Renault (2009), we open coded "we examine them [business models] as market devices, focusing on their materiality, use and dynamics." In iterative subsequent steps, we went through the codes, excerpts, and memos again and built categories by clustering and abstracting them (Glaser & Strauss, 1967; Wolfswinkel et al., 2011; Xiao et al., 2013). The codes, memos, and excerpts were discussed by the two coders to ensure agreement on meanings (Strong & Volkoff, 2010). In a final step, we reviewed resulting categories with their associated memos and excerpts and labelled the categories according to their use and meaning. This labelling was also synchronized (we named the few applications already discussed in the literature with their established labels: For example, one application was named "unit of analysis" according to Zott et al., 2011) with the existing literature on business models (Strauss & Corbin, 1990; Wolfswinkel et al., 2011; Xiao et al., 2013). For instance, the article by Doganova and Eyquem-Renault (2009), introduced above as a coding

example, was ultimately clustered in the application that was later labelled the "unit of analysis." This means that the authors applied the business model concept as a unit of analysis in their work.

2.2.3 | Problems, theoretical foundations, and methods

Following Dibbern et al. (2004), we adopted Benbasat and Weber's (1996) three dimensions in our analytical framework to cover research diversity. We include the *problems* dimension via major topics, research objectives/questions, dependent variables, and Gregor's theory types (Gregor, 2006). The theoretical perspectives used in the articles are examined to cover the *theoretical foundations* dimension. Classifying outcomes based on theory types and perspectives improves understanding of existing research and its contributions. Finally, we include the *methods* dimension by analysing the details of each article, such as the methodology used, levels of analysis (Davidsson and Wiklund (2001), sample contexts, and paradigms (Xiao et al., 2013). The insights gained through the method part of our analytical framework will help to better depict what has been researched, from which levels of investigation, and with what tools.

Data collection and analysis of the dimensions' details were similar to the approach for the "application of the business model concept" described above, ie, open and inductive coding as well as abstraction (Dibbern et al., 2004; Wolfswinkel et al., 2011).

3 | REVIEW RESULTS

Based on our analytical framework, we compiled a map (see Table 3) that summarizes the literature review for a quick overview. We also focus the map on the most frequently found patterns (Xiao et al., 2013).[1]

3.1 | The diffusion of IT in the business models of new ventures

The business model is mainly used in two functions: (1) Every venture has some (real) business model that depicts its business logic either implicitly or explicitly and (2) the business model is also used as a tool by researchers to analyse, describe, and classify businesses (Baden-Fuller & Morgan, 2010).

In our first step, we analysed the "real" business models as described and treated by the authors of the reviewed articles for their study sample and case firms (not the business model concept as used by the researchers conducting the study). We thereby used the introduced pillars of Osterwalder et al. (2005) to analyse the diffusion of IT in the business models of entrepreneurial ventures as described in the articles. All ventures in the samples and cases of the reviewed articles (292) use IT in the *infrastructure management* business model pillar. Furthermore, 102 also use it in the *customer interface* business model pillar, and 220 have IT as the *product* pillar in their business model. By analysing the co-occurrences of these diffusions in the three pillars, we found four typical patterns of the use of IT in the business models of entrepreneurial ventures.

3.2 | Problems: topics and outcomes of existing work

We found strong differences in the common topics among the four patterns of IT diffusion in entrepreneurial business models.

First, studies on new ventures that *only use IT in the infrastructure management* pillar of their business models (*Pattern 1*) are dominated by traditional IS research on IT adoption, diffusion, and alignment. Closely related outcome variables, such as the adoption or use of a new technology, are mostly used. For instance, Cragg, King, and Hussin (2002) surveyed the alignment of strategy and IT in 256 small, young manufacturing ventures in the United Kingdom. Other than the existing literature, no specific theoretical lens is mentioned. The authors found that such

[1]It is important to keep in mind that the numbers in this map do not necessarily add up to 100%. This is because an article might use more than one method, for instance.

TABLE 3 Summary of the literature review results

Business models	Diffusion of IT in the business model of the sample ventures	Pattern 1: In the infrastructure management pillar of the business model	Pattern 2: In the infrastructure management and the customer interface pillars	Pattern 3: In the infrastructure management and the value proposition/product pillars	Pattern 4: In the infrastructure management, the customer interface, and the value proposition/product pillars
	Scientific application of the business model concept[a]	As a result 0% Only mentioned 25% Sampling & grouping 2% Template 5% Unit of analysis 2%	As a result 0% Only mentioned 33% Sampling & grouping 13% Template 0% Unit of analysis 13%	As a result 1% Only mentioned 18% Sampling & grouping 1% Template 0% Unit of analysis 6%	As a result 0% Only mentioned 23% Sampling & grouping 0% Template 0% Unit of analysis 23%
Problems: topics, theories, and outcomes	Main topics	Adoption and innovation, funding/investment, strategy and alignment, and policy	Strategy and alignment, governance, alliances, adoption, and innovation	Performance, adoption and innovation, strategy and alignment, and funding/investment	Strategy and alignment, funding and investment, outsourcing, and organization
	Applied theoretical perspectives	Institutional theory, dynamic capabilities, resource-based view, innovation diffusion theory, and entrepreneurial action theory	Agency theory, resource-based view, social capital, and innovation diffusion theory	Resource-based view, institutional theory, signalling theory, economic theory, network theory, and population ecology	Resource-based view, agency theory, network externalities, dynamic capabilities, and network theory
	Outcome variables	Adoption, use, competitive advantage, financial performance, and IT alignment	Financial performance, market value/funding, exit, decision speed, and product/service innovations	Financial performance, survival, entry/exit, funding/IPO performance, and patenting	Financial performance, survival, page views/downloads, new orders, and entrepreneurial agility
	Theory types of outcomes	Analysis 10% Design & action 2% Explanation 62% Explanation & pred. 24% Prediction 2%	Analysis 7% Design & action 0% Explanation 36% Explanation & pred. 43% Prediction 14%	Analysis 16% Design & action 1% Explanation 36% Explanation & pred. 45% Prediction 2%	Analysis 11% Design & action 0% Explanation 67% Explanation & pred. 11% Prediction 11%
Methods and sample contexts	Methods[a]	Case study 43% Conceptual 22% Experiment 2% Review 2% Secondary data 10% Survey 22%	Case study 14% Conceptual 21% Experiment 7% Review 0% Secondary data 36% Survey 21%	Case study 21% Conceptual 5% Experiment 1% Review 1% Secondary data 49% Survey 22%	Case study 44% Conceptual 17% Experiment 11% Review 0% Secondary data 22% Survey 6%
	Epistemological paradigms[a]	Interpretive 22% Positivist 36%	Interpretive 14% Positivist 64%	Interpretive 6% Positivist 74%	Interpretive 33% Positivist 44%
	Levels of analysis[b]	Individual 14% Group/team 4% Product 0% Business model 2% Firm 62% Industry 14% Country 14% Society 0% Multi-level thereof 8%	Individual 14% Group/team 14% Product 0% Business model 14% Firm 79% Industry 14% Country 0% Society 0% Multi-level thereof 29%	Individual 10% Group/team 9% Product 6% Business model 4% Firm 70% Industry 24% Country 6% Society 0% Multi-level thereof 21%	Individual 11% Group/team 0% Product 0% Business model 17% Firm 61% Industry 6% Country 0% Society 6% Multi-level thereof 0%

(Continues)

TABLE 3 (Continued)

Business models	Diffusion of IT in the business model of the sample ventures	Pattern 1: In the infrastructure management pillar of the business model	Pattern 2: In the infrastructure management and the customer interface pillars	Pattern 3: In the infrastructure management and the value proposition/product pillars	Pattern 4: In the infrastructure management, the customer interface, and the value proposition/product pillars
	Industries	Cross-industry, social industry, and manufacturing	B2C e-commerce and B2B e-commerce	Software, hardware, and IT services	Electronic marketplaces, online media, and group buying
	Countries	US, UK, India, Canada, Spain, and Portugal	US, China, international, and Germany	US, international, China, Japan, and the Netherlands	US, China, UK, France, and Japan
Outlets	Disciplines	E-Ship 22% GSM 7% IS 71%	E-Ship 7% GSM 53% IS 40%	E-Ship 41% GSM 43% IS 16%	E-Ship 17% GSM 22% IS 61%

Abbreviations: B2B, business-to-business; B2C, business-to-consumer; E-Ship, entrepreneurship; GSM, general and strategic management; IPO, initial public offering; IS, information systems; IT, information technology.

[a]Does not have to add up to 100%—other/na results not shown.

[b]Can add up to more than 100% due to multilevel analyses.

ventures often achieve high IT alignment through their agility, and high alignment led to higher performance by the ventures. This can be seen as a transfer of traditional IS research from the focus on established firms to a focus on entrepreneurial ones.

Moreover, we want to highlight a very recent development in this area, namely, the use of IT to facilitate financial resource acquisition and funding (ie, initial coin offerings via blockchain or traditional crowdfunding) (Preston, 2018). For instance, Mollick (2014) investigated the question "what makes a venture's Kickstarter campaign successful?" To do so, he used signalling theory and a secondary data sample harvested from kickstarter.com. He found that ventures signalling higher quality, with founders who had many friends in social networking sites, reached higher funding levels. This was fostered by a strong fit, in which founders requested funding for projects that were inherent to their geographical culture.

Second, research on new ventures *using IT in their infrastructure management and in the customer interface pillar* (*Pattern 2*) is dominated by strategy and alignment topics. These topics are closely related to outcome variables such as financial performance, firm or market value, and firm exit. This focus mirrors the dominance of management scholars in that area. An example can be found in Kim, Nam, and Stimpert (2004), who used Porter's (1985) generic strategies to conceptualize the strategic positioning of new e-commerce ventures. They argue that combining differentiation and cost leadership strategies in e-commerce ventures does not lead to the "stuck in the middle" problem as suggested by Porter but that this combination will instead outperform the individual strategies.

Third, when *IT is the main value proposition and product of a venture's business model* and thereby is also used in the *infrastructure pillar of the business model* (*Pattern 3*), the predominant topics are the performance, alignment, and funding of such ventures. Studies within this area mostly focus on outcome variables such as financial performance, survival, or funding performance; these outcome variables are typical for entrepreneurship research. A large portion of the studies focus on software-based start-ups. Using a case study, Hallen and Eisenhardt (2012) explored how nine software start-ups efficiently established ties with investors. The work was framed using resource dependence and network theories. The resulting theory suggested two paths for forming ties with investors: (1) existing strong and direct ties that can only be used by a few privileged firms and (2) catalysing strategies used by executives to establish new opportunities for network ties through actions in existing networks and/or signalling. The business model is mentioned in the article as an object about which to seek general entrepreneurial advice in casual settings, such as dinner parties with networking partners (eg, investors).

Fourth, research that looks at the *fourth pattern*, where all three pillars of the business model (*the infrastructure management*, *the customer interface*, *and the value proposition/product pillars*) are permeated by IT, reveals a diverse set of topics, ranging from strategy and alignment to funding and organizational issues. Commonly used outcome variables include both traditional ones (ie, financial performance, firm survival, or entrepreneurial agility) and newly introduced performance measures (eg, page views measured through alexa.com ranks). Currie and Parikh (2006) used dynamic capabilities theory and Porter's competitive strategy theory to conceptualize the value creation process in web services start-ups. The business model concept was leveraged as a unit of analysis to analyse the value creation process. Twelve propositions are presented as the results of a conceptualization that was, in turn, based on the different parts of the business model (eg, the pricing model).

3.3 | Theoretical foundations used in existing work

We found commonalities in the theories used within all patterns. In particular, the resource-based view is often applied in all four patterns. The same holds for the closely linked use of (dynamic) capabilities theory. This might be explained through IT being seen as an important resource or capability, especially in Pattern 3, because these ventures completely rely on IT as a product. An example of the use of the resource-based view can be found in Wagner and Cockburn (2010). Using secondary data of 356 young internet firms, the authors evaluated the impact of patenting behaviour on survival. Patents are specifically suited to the resource-based view because they commonly contain characteristics that are important for sustainable competitive advantage (Barney, 1991).

For the Patterns 1 (IT used only in the infrastructure pillar) and 3 (IT used in the infrastructure pillar and as a main product or service), we additionally found that institutional theory (DiMaggio & Powell, 1983) was often used as a theoretical frame. Institutional theory allows to investigate how new ventures gain legitimacy in different contexts or cultures and how they adapt to pressures from such contexts to do so (ie, isomorphism). Petkova, Rindova, and Gupta (2013) used institutional theory to study how media attention relates to legitimacy and evaluation by venture capitalists. The study was conducted with a sample of IT firms, and the authors found that media attention can build legitimacy for young firms, especially when they engage in specialized industry media. This in turn leads to higher levels of venture capital funding, which general (nonspecialized) media attention does not.

The authors of articles focusing on new ventures that only use IT in the infrastructure management pillar (Pattern 1), or additionally in the customer interface pillar (Pattern 2), often applied innovation diffusion theory (Rogers, 2003). One instance is the case study by Molla, Heeks, and Balcells (2006), who analyse the diffusion of e-commerce in a wine retailing start-up. They develop a process view and propose several factors that positively or negatively influence the process. Lastly, we found that network theory (Granovetter, 1973) is used sporadically in articles focusing on new ventures that only use IT in the infrastructure management pillar (Pattern 1) or in all pillars (Pattern 4). Network theory helps us to understand the importance of strong and weak ties between network nodes (ie, people in a network). One article used network theory to investigate how the network ties of founders influence funding performance of start-ups (Shane & Cable, 2002).

3.4 | Methods and sample contexts used in existing work

Our analyses showed that the predominant methodological approaches are case studies and secondary data research. Case study research was most common in the patterns (ie, Patterns 1 and 4), in which most articles were from the IS outlets. The patterns dominated by articles from the entrepreneurship and GSM outlets favoured secondary data approaches. This breakdown reflects typical methodological differences among the three disciplines (Crook, Shook, Morris, & Madden, 2010; Sarker, Xiao, & Beaulieu, 2013). Very similar and closely connected patterns are found in the paradigmatic worldviews. Positivist research dominates all patterns, but the proportion of interpretive articles is larger for the patterns that mostly stem from IS outlets.

Our review of the levels of analysis used in the studies showed that most research in all four patterns focuses on the firm level. Industry-level research was also common, especially when IT was used by the ventures as the main product in the business model (Pattern 3) or only in infrastructure management (Pattern 1). Industry-level analysis is often closely linked with the population ecology theory, which allows analysing market entries and exits in a specific industry. The business model occasionally served as a level of analysis, particularly in articles of Patterns 3 and 4.

3.5 | Outlets for existing work in IS, entrepreneurship, and general and strategic management

The distribution of the final sample of articles among the selected journals can be found in Figure 1. Almost all IS journals appeared to publish quite a large number of IT-associated entrepreneurship research. While the *Journal of Strategic Information Systems* can be considered to have published above-average numbers of articles, and most other IS journals published around average numbers, the *Journal of the Association for Information Systems* revealed a below-average number, possibly because that journal was only established in the year 2000. While the numbers in the IS journals showed a roughly even distribution, the entrepreneurship journals showed the opposite. The *Journal of Business Venturing and Research Policy* published the most articles relevant to our topic by far, while *Entrepreneurship: Theory & Practice* and the *Strategic Entrepreneurship Journal* showed around average numbers. In the case of the latter (ie, *SEJ*), this might again be explained by the journal's recent establishment (2007). The GSM journals also displayed a rather heterogeneous distribution, with the *Academy of Management Journal*, *Management Science*, and the *Strategic Management Journal* publishing an above-average number of articles, and the rest publishing below-average numbers.

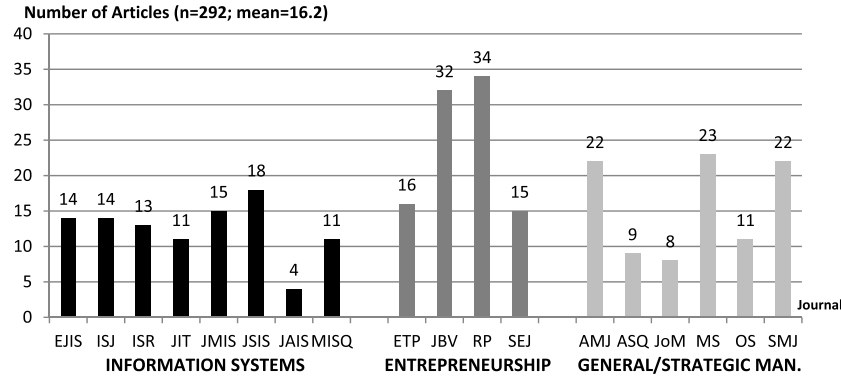


FIGURE 1 Distribution of IT-associated entrepreneurship research articles in journals. *AMJ*, *Academy of Management Journal*; *ASQ*, *Administrative Science Quarterly*; *EJIS*, *European Journal of Information Systems*; *ETP*, *Entrepreneurship: Theory and Practice*; *ISJ*, *Information Systems Journal*; *ISR*, *Information Systems Research*; *JBV*, *Journal of Business Venturing*; *JIT*, *Journal of Information Technology*; *JMIS*, *Journal of Management Information Systems*; *JoM*, *Journal of Management*; *JSIS*, *Journal of Strategic Information Systems*; *JAIS*, *Journal of the AIS*; *MISQ*, *MIS Quarterly*; *MS*, *Management Science*; *OS*, *Organization Science*; *RP*, *Research Policy*; *SEJ*, *Strategic Entrepreneurship Journal*; *SMJ*, *Strategic Management Journal*

We found strong differences among the journals publishing articles within the different patterns. Information systems journals are especially strong regarding research on entrepreneurial ventures that use IT only in the infrastructure management pillar of their business model (Pattern 1). This is not unexpected, as it is just an extension of core IS research on adoption and diffusion to the context of new ventures. Interestingly, GSM dominates research output in Pattern 2, where IT is used in the infrastructure management and the customer interface pillars (eg, e-commerce start-ups), while there are almost no articles in the entrepreneurship journals. It was even more surprising that research on new ventures producing genuine IT products or services (Pattern 3) was heavily dominated not only by the entrepreneurship journals but also by the GSM outlets. Finally, when IT was used throughout all pillars of the business model (Pattern 4), IS journals strongly dominated the research output on such digital start-ups.

3.6 | Application of the business model concept in IT-associated entrepreneurship research

A business model can be the existing business logic of a real venture or a tool for scientific inquiry (Baden-Fuller & Morgan, 2010). In contrast to the section above, we will now analyse the scientific use of the business model concept by scholars developing the articles reviewed here. Almost 40% (112) of the authors of the reviewed articles (292) explicitly used the business model concept in one way or another. Screening and inductively clustering the articles resulted in five typical applications of the business model concept in IT-associated entrepreneurship research. The concept is most often mentioned as (1) *an illustration of change* (73 articles), followed by its application as (2) *a unit of analysis* (28 articles). Some articles leverage the business model as (3) *a strategy for sampling and grouping* (seven articles), while a small number harness it as (4) *a template for designing and aligning IT* to business needs and activities (three articles). The business model was the resulting (5) *product* of research in only one article. We explain the details of these patterns in the following.

(1) The business model as an illustration of change

The most common application of the business model concept that we found during our review was a rather frequent use of the term. However, many authors talk about the business model without further defining it or elaborating on it in this common use pattern (eg, Soh, Markus, & Goh, 2006). In most cases, this type of application was associated

with illustrating change in the ways of doing business, a change that was induced by technological (ie, IT-driven) or societal shifts (eg, von Krogh & Haefliger, 2010; Zahra & George, 2002). In this case, the business model concept is neither used in-depth in the theoretical foundations nor in the method section.

(2) The business model as a unit of analysis

The business model concept was frequently applied as a unit of analysis to gain insights into the impacts of technology-induced business opportunities. Authors of this case usually introduce the business model and its facets as a research device in their theoretical or method parts. They then analyse the business model in depth. For example, Ojala (2016) investigated the business model innovation of a software start-up over 15 years during the founders quest for a viable business logic. He thereby explains how the founders developed the first business model and then evolved it adapting to changes in their offers or in the market to create and capture value. Further examples from our review include Gilbert (2005), who uses it for an in-depth case study on resource rigidity in the business models of online news ventures, or Dos Santos, Patel, and D'Souza (2011), who conceptualize business models as a unit of risk analysis in association with venture capitalist funding. Applying the concept in these ways aligns well with the literature that sees the greatest potential of the business model concept in its use as an analytical unit (eg, Zott et al., 2011).

(3) The business model as a strategy for sampling and grouping

Quantitative analysis at the firm level has often led to the overlooking of specific characteristics inherent to a firm's value-creating business activities. Existing research offers a range of typologies and taxonomies (eg, for e-health business models) that enable better selection and grouping of samples or subsamples by business model types or taxa (Lambert, 2015; Nickerson et al., 2013). Authors can then select firms using different types of business model and thereby separate effects that are induced by one specific type. This strategy is, for example, used by Eisenmann (2006) in applying his eight generic business model types of internet companies. He thereby explains their rapid growth, as well as the drivers—such as network effects—that are inherent to specific business model types. Additionally, the business model has also been used in a similar manner as a control variable to distinguish between online and offline firms, which is not always a trivial task when conducting analyses at the firm level (eg, Uhlenbruck, Hitt, & Semadeni, 2006). Depending on the specific use, the business model is either introduced in the theoretical part or it is only very briefly reflected upon in the method section (if only used as a control variable).

(4) The business model as a template for designing and aligning IT

Two articles were found to apply the business model as a template for designing and aligning IT artefacts. One article in our review covers a start-up that wants to become an online retailer. Using an action research approach, Molla et al. (2006) leverage the business model concept to develop requirements for this endeavour. They thereby depict the different elements of the business model and define how the new system should be designed to support the inherent business logic. Poba-nzaou and Raymond (2011) use a multiple-case study to understand the alignment of enterprise resource planning (ERP) systems with the business model. They therefore analyse the coherence between the new processes after the ERP implementation and the business model. Their findings accentuate the importance of alignment between ERP processes and business models for successful implementation.

(5) The business model as a product

Definitions or specifications of a business model or business model patterns can be the outcome of research. One article used an action research approach to investigate interorganizational IT innovation and thereby developed a business model-type description as one main part of the results (Andersson, Lindgren, & Henfridsson, 2008). Nevertheless, there has been a substantial amount of literature, outside of our entrepreneurial focus, that has produced outcomes such as types and taxa or components of business models (eg, Osterwalder et al., 2005; Timmers, 1998; Zott et al., 2011).

Looking at the three different disciplines reviewed here, we find that IS scholars appear to use business models most frequently by only mentioning them as illustrations of change (see Figure 2). Information systems scholars also largely use the business model as a unit of analysis, and their discipline is the only one to use it as a template and as a result. This might be due to the fact that IS scholars are more familiar with design science approaches, which align well with these latter two uses.

4 | THE ROLES OF IT IN ENTREPRENEURSHIP AND RELATED DEFINITIONS

On the basis of our results and corresponding patterns, we develop definitions and present general insights into the associated value creation logic and discuss potential paths for transitioning from one pattern to another (ie, type). In a next step, we then outline potential ideas for future research, based on the identified gaps.

4.1 | Defining IT-associated entrepreneurship

As introduced above, we found varying patterns of co-occurrences of IT use in the business models of the study samples and cases in the reviewed articles. From these patterns, we develop a classification of the roles of IT use within start-up business models. The roles can be used in various ways. They point to different applications of IT; thus, they might clarify the knowledge and skills needed by entrepreneurial teams whose ventures fall into the various categories (Kollmann, Häsel, & Breugst, 2009), for instance. We use the roles to clarify the blurry definitions of IT-associated business models, which is seen as the foundation for research in a field (Bygrave & Hofer, 1991, p. 13). To date, to the best of our knowledge, no comprehensive definitional set exists. On the contrary, authors frequently do not define or distinguish among internet business models, e-commerce business models, online business models, internet start-ups, e-start-ups, e-ventures, digital start-ups, IT start-ups, etc (eg, Kollmann, 2006).

In the following discussion, the patterns are explained and interpreted as the four roles of IT in entrepreneurship (see also Figure 3). When IT plays any of these four roles, we call the phenomenon IT-associated entrepreneurship research. When IT is not used at all by the entrepreneurial venture, then IT has no role, and this is where articles would be beyond the scope of this review (depicted by the box on the bottom left of Figure 3). We call these ventures non–IT-associated start-ups.

First, IT's most traditional role in new ventures is that of a *facilitator*, or tool for supporting or enhancing venture operations that were previously performed with calculators, files, and phones, as well as with pen and paper (eg, Caldeira & Ward, 2002). In a second role, IT can also be used as a channel that links a firm and its customers via networks. We call this role the *mediator*. Third, IT can also be an *outcome* of the operations of a firm, as in the case of physical (eg, Henderson, 2011) or digital products (eg, Deodhar, Saxena, Gupta, & Ruohonen, 2012). And

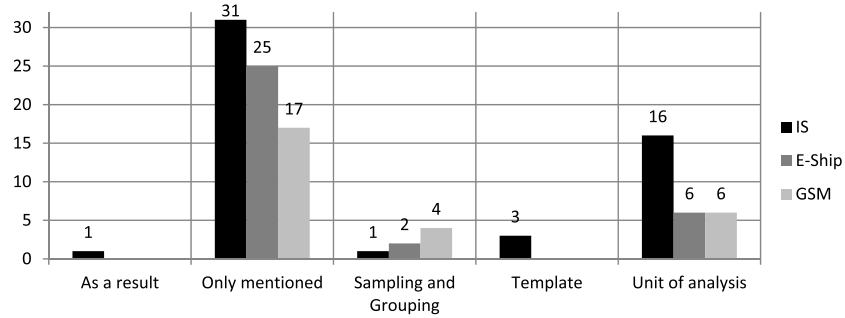


FIGURE 2 Use of the business model concept in IT-associated entrepreneurship articles in the disciplines. E-Ship, entrepreneurship; GSM, general and strategic management; IS, information systems

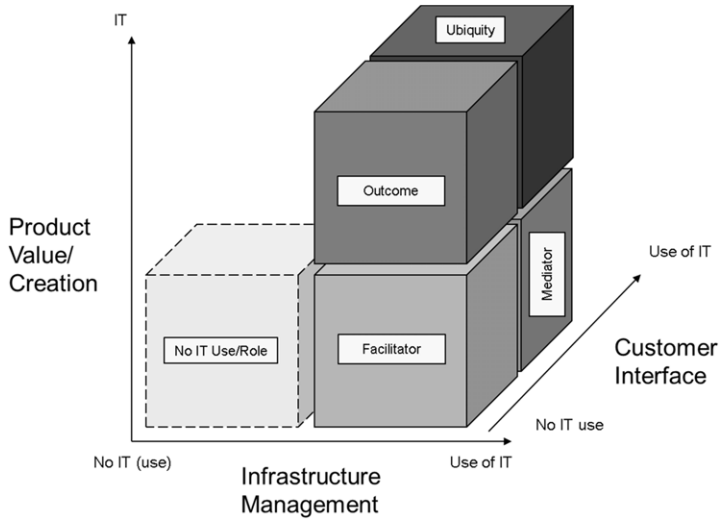


FIGURE 3 Typical co-occurrences of it use in entrepreneurial business models. IT, information technology

fourth, the youngest role that IT can take on in entrepreneurial ventures is that of a *ubiquity*. Information technology is thereby heavily used in all three pillars of the business model (eg, Gnyawali, Fan, & Penner, 2010). These four roles are more deeply explained in the following. We organize our explanations for each role around the value creation logic, which is central to the business model concept, definitions that we suggest for start-ups using each role, and the transitioning to each role. As introduced above, business model transitioning (ie, evolution) is particularly common for start-ups on their long quest for viable business logic.[2]

4.1.1 | IT as a facilitator of entrepreneurial operations

Value creation logic

Porter (1985) explains value creation and capture through the activities of firms and distinguishes primary (eg, production or sales) and supporting activities (eg, infrastructure). Information technology, in its role as a facilitator of entrepreneurial operations, is located in the infrastructure pillar of the business model. It is thereby used in the supporting activities and can enhance performance of primary activities such as operations or service (eg, through an ERP system). This can be closely linked to the orchestration of the efficiency-oriented business model (Zott & Amit, 2010).

In the first pattern that we discovered during our review analyses, entrepreneurial ventures solely use IT in the infrastructure management part of their business model (see Figure 3). More specifically, 63 (55) of the IT-associated entrepreneurship articles that we reviewed included, in their samples or cases, young firms that use IT to facilitate or optimize their operations. Facilitation is typically enabled by adopting hardware (eg, computers and printers) and/or software (eg, systems for task and knowledge management or enterprise resource planning). Examples include Caldeira and Ward (2003), who investigate small manufacturing firms' IS adoption and innovation processes, or Choudrie and Lee (2004), with their country-level investigation of broadband innovation diffusion among start-ups. New ventures that use IT solely to facilitate their entrepreneurial operations frequently use traditional business models, such as manufacturing or retailing. Summarizing the value creation logic for this role, value is defined as "the amount buyers are willing to pay for what a firm provides them. Value is measured by total revenue […]. A firm is profitable [and thereby creates value for its shareholders] if the value it commands exceeds the costs involved in

[2]When interpreting the numbers presented below, it is important to understand that some articles elaborate on more than one role due to their use of diverse samples. Thus, the totals exceed our analysed sample of 292 articles. We additionally present the articles that focus only on homogenous samples of the specific individual role, which is presented in parentheses.

creating the product" (Porter, 1985, p. 38). Hence, the indirect value creation effect of IT, when used by a start-up in this role, is that it can improve the performance of primary activities and enable cost-savings.

Definitions for start-ups using the role

We suggest defining the generic business models of such start-ups that solely use IT in the infrastructure management part of their business model as *IT-facilitated business models*. These suggestions are based on the assumption that the value creation and delivery of these ventures can also potentially occur without the facilitating properties of IT. Information technology is only substituting supporting activities that have before been accomplished via pen-and-paper or calculator. Information technology now enhances efficiency. Extending this avenue, we suggest defining such ventures as *IT-facilitated start-ups* because IT makes life of the entrepreneurs easier without directly impacting their main value creating activities.

Transitioning to this role

To become an IT-facilitated start-up, the most common and probably only transition process is the shift from no IT use to the use of IT in the role of a facilitator. This will involve changes through the adoption and use of IT within the supporting activities of the firm's value chain because "all new business models are variations on the generic value chain underlying all businesses" (Magretta, 2002, p. 4). One example of this transition in our review sample is a food start-up that introduced an IT system to improve operations (Whitley, 1999). That start-up thereby changed the content of activities within the supporting activities of its business model to improve the performance of its core activities. This approach can be called an efficiency-centred activity systems design, because the business model is evolved and configured for cost savings (Zott & Amit, 2010).

4.1.2 | IT as a mediator of entrepreneurial operations

Value creation logic

A second pattern identified in our analysis was the frequent co-occurrence of IT use in both the infrastructure and the customer interface pillars of the business model (see Figure 3). This role of IT in entrepreneurial settings was found in 74 (15) articles. Information technology thereby takes on the role of a *mediator*, connecting the start-up with its clients over IT-mediated networks (ie, the internet) for value creation and/or value delivery; thus, IT can be seen as enabling entrepreneurial operations. Sales are defined as one of the five primary activities in the generic value chain of a firm (Porter, 1985). If a start-up uses IT in the role of a mediator, it creates and captures value through introducing a new IT-mediated sales channel that enhances customer experience, which is directly intertwined with the product or service as a part of the use value (Bowman & Ambrosini, 2000). Examples include e-commerce start-ups (eg, Zalando). An instance of research on IT-mediated start-ups is Kim et al. (2004), who investigate the performance of e-commerce ventures by applying Porter's generic strategies.

Definitions for start-ups using the role

Ventures creating and capturing value by using IT mainly in both the infrastructure and customer interface pillars of the business models usually rely strongly on IT mediation of their customer interfaces. We shall therefore define such business logic as *IT-mediated business models* because IT-mediation is the dominant element of this set-up. Subsequently, we define the firms themselves as *IT-mediated start-ups*. We use this nomenclature because value is created through the mediating role of IT and the production or/and sale of physical goods or services.

Transitioning to this role

As introduced above, entrepreneurs are constantly seeking to enhance their value creation and capture logics, which can lead to business model transitioning. A typical pattern for transitioning to the role of an IT-mediated start-up is the introduction of a new IT-mediated channel. This not only enhances internal value creation and capture through cost

savings but also adds a new value dimension for the external transaction partners. The authors of one of the articles in our review analysed such efforts, focusing on a wine retailing start-up's transition from an IT-facilitated to an IT-mediated start-up. The start-up pursued this transition through the set-up of a new sales channel via an online store (Molla et al., 2006). The novelty introduced into the business model design therefore stemmed from an additional IT-mediated sales channel, which is a new content activity within the primary value chain activities (ie, sales) (Porter, 1985; Zott & Amit, 2010). This channel might add customer value through the sales process on top of the product value. Hence, a firm might enhance its value creation and competitiveness by relying on a novelty-centred business model design as detailed in this example. Business model innovation thereby complements innovation in products (Amit & Zott, 2007). This type of transition is more complex than the simple adoption of a single IT system as it involves several areas of reconfiguration within the value chain.

4.1.3 | IT as an outcome of entrepreneurial operations

Value creation logic

A third pattern we identified was the co-occurrence of IT use in the infrastructure and product pillars of the entrepreneurial business model (see Figure 3). We refer to this role of IT as the *outcome* (ie, product) of entrepreneurial operations. In all, 170 (135) of the reviewed articles used samples or cases that included this role of IT. Looking at this role from a value chain perspective, we can see that IT is situated in the core centre of the primary value-creating activities because it is the result of operations itself and is sold as the final product (Boehm & Sullivan, 2000; Porter, 1985). New ventures producing software, hardware, or offering IT services are instances where value creation and capture is mainly based on IT as the produced outcome. An exemplary article within our review elaborates on the legitimacy building of a new software venture developing physician order-entry systems (Kaganer, Pawlowski, & Wiley-Patton, 2010).

Definitions for start-ups using this role

We further rely on value creation logic (Amit & Zott, 2001) and suggest defining the business model of such start-ups that produce IT products as *IT-bearing business models* if they use IT mainly in the infrastructure and product pillars. This follows the assumption that value created by these start-ups and their business models is mainly based on and in IT as the final outcome to be sold—ie, these start-ups are bearing new IT products. We consequently name these new ventures *IT-bearing start-ups* in the following.

Transitioning to this role

This type of transition to an IT-bearing start-up and business model is rather seldom found. The reasons might be that this transformation requires a complete change of core value–creating competencies, with a shift towards the production (ie, bearing) of IT-based products or services, which also involves a change of industry if this role of IT becomes dominant. However, particularly the Internet of Things and Industry 4.0 trends have increased such changes recently. From a value chain perspective, this transition requires changing many of the firm's primary and supporting activities. Here, value creation and capture is changed by IT becoming a central part of the product and core competency. Examples of such a switch include start-ups that realize that a self-developed IT artefact introduced to improve the performance of their operations is a marketable product in itself. This novelty-centred innovation potentially changes not only the content but also the structure activities of the business model (Zott & Amit, 2010). Start-ups that entered the market with an analogue product and are now seeking to innovate through digitization becoming an inherent part of their product might also be candidates for such a shift.

4.1.4 | IT as a ubiquity in entrepreneurial operations

Value creation logic

The fourth and final pattern we identified is the frequent co-occurrence of IT in all three pillars of the business model (see Figure 3). The value creation of such firms and their business models thereby completely relies on the IT-mediated

offering of digital products or services (Kauffman & Walden, 2001; Rayna, 2008). From a value chain perspective (Porter, 1985), IT plays central roles not only in the firm's primary sales, logistics, and services activities through IT-mediation but also in its operations through the production and enabling of digital products or services. Also, supporting activities of the value chain are usually permeated by IT, for instance, in the firm infrastructure. Examples of such ventures are cryptocurrency start-ups (eg, Ethereum), marketplaces (eg, Etsy), cloud services (eg, Dropbox), or social network sites (eg, Facebook). One example of such an article is the investigation of Perlow, Okhuysen, and Repenning (2002), who elaborate on the speed trap of decision-making in an online lecture notes start-up.

Definitions for start-ups using this role

Following these insights, we define business logic that uses entirely IT-mediated processes and digital products or services for value creation and transfer as *digital business models* and associated new ventures as *digital start-ups* (Davidson & Vaast, 2010). We found that 81 (23) of the reviewed articles included *digital start-ups* in their cases or study samples, but only 23 were purely focused on *digital start-ups* as defined by us, as the literature shows a high degree of confusion around the definitions of IT-associated new ventures. Many of the 81 articles claim to study "internet start-ups," "electronic start-ups," or others. According to our definitions, the 81 articles thereby also included IT-mediated start-ups.

Transitioning to this role

A firm might enhance value creation and competitiveness by relying on a business model configured for novelty or lock-in. However, novelty—in this case of transitioning to a digital start-up—might involve several mechanisms. An example is a traditional software firm that transfers its offered products to digital services (ie, the cloud) (Kaltenecker, Hess, & Huesig, 2015) or an online store that sold and shipped physical music CDs and then switched to selling MP3s and directly delivering them via downloads or streaming. In the review, we found an article that looked at a computer graphic agency start-up that tried transitioning to a digital start-up by testing several new business models, such as an online greeting card service, but ultimately failed (Drori, Honig, & Sheaffer, 2009). Such business model innovations potentially change not only content and structure but also the governance of the value chain activities making them rather complex (Zott & Amit, 2010). This often involves migrating a part of the value creation process to customers or other actors outside of the boundaries of the firm that brings a changed activity governance structure: Social media start-ups rely heavily on user-created content as a part of their value creation logic, for instance (Gnyawali et al., 2010; Grönroos & Ravald, 2011; Pagani, 2013). In the extreme form of value co-creation and innovation, such business models are called open business models (Chesbrough, 2006).

4.2 | Summary and development over time

In summary, the four developed roles of IT in entrepreneurial ventures can help us to better comprehend and define IT-associated business models and start-ups. They can also enable us to distinguish patterns in the use of IT in business models. We have carefully summarized and depicted all definitions we developed throughout this review (see Table 4). The columns indicate the role of IT in the entrepreneurial setting and are amended with details on the value creation process that stem from the business model literature (Amit & Zott, 2001).

We see these roles and definitions as a contribution to clarifying the existing confusion that surrounds definitions of IT-associated entrepreneurship. Moreover, distinguishing among the four types can help future research to better address and analyse the specifics of each type through a deeper understanding of the role of IT and associated value creation, as explained above. Such typologies have been identified as being very important, especially in emerging fields like IT-associated entrepreneurship research (Wolf, 1926), because they will not only allow researchers to choose theoretical lenses or methodologies particularly tailored to the settings of a type but also enhance sampling for each type, allowing researchers to better generalize and uncover opposing effects between the types (Al-Debei & Avison, 2010; Lambert, 2015).

TABLE 4 Overview of the developed definitions for information technology (IT)–associated entrepreneurship and business models

	Facilitator	Mediator	Outcome	Ubiquity
Value created through:	Sale of traditional goods or services	Mediation and physical delivery, sale of traditional goods or services	Sale of hardware or software	Completely digitized product or service, digitally sold and delivered
Diffusion of IT in the business model of sample ventures	In the infrastructure management pillar of the business model	In the infrastructure management and the customer interface pillars	In the infrastructure management and the value proposition/product pillars	In the infrastructure management, the customer interface, and the value proposition/product pillars
Proposed definitions	• IT-facilitated business models • IT-facilitated start-ups	• IT-mediated business models • IT-mediated start-ups	• IT-bearing business models • IT-bearing start-ups	• Digital business models • Digital start-ups

To better understand the development of the roles in the literature over time, we have compiled a graph that shows the percentage of articles elaborating on each specific role over the last 27 years (see Figure 4). It can be seen that research on start-ups using IT in the role of an *outcome* was most prominent in the early years of our analysis, while its proportion has decreased over time. A rather similar development was found for research on new ventures with IT in the role as a *facilitator*, while research on IT as a *mediator* had a larger portion beginning only after the burst of the dotcom bubble and has since been on the decline again. For research on IT as a *ubiquity*, we also see the main starting point in the early 2000s and a constant increase since then. In the following, we use the roles of IT and the four developed definitions of IT-associated start-ups to create an agenda for future research.

To provide a better summary of reviewed findings, we have constructed graphical syntheses for research on each start-up type (see Appendix B). These overviews integrate the main findings with a specific focus on firm-level research. As can be seen, the patterns differ strongly per start-up type. For instance, IT-facilitated start-up research is largely dominated by adoption and use as drivers of new venture performance. Also, IT capabilities play a major role here. Contrasting, research on the performance drivers of IT-mediated start-ups has mainly argued for strategy and governance to be important dimensions.

Understandably, IT-bearing start-ups have been researched rather from a product and product portfolio viewpoint. Developing and bringing innovative IT products to the market is found to be very important as well as the strongly researched challenge to protect intellectual property for this type of start-ups.

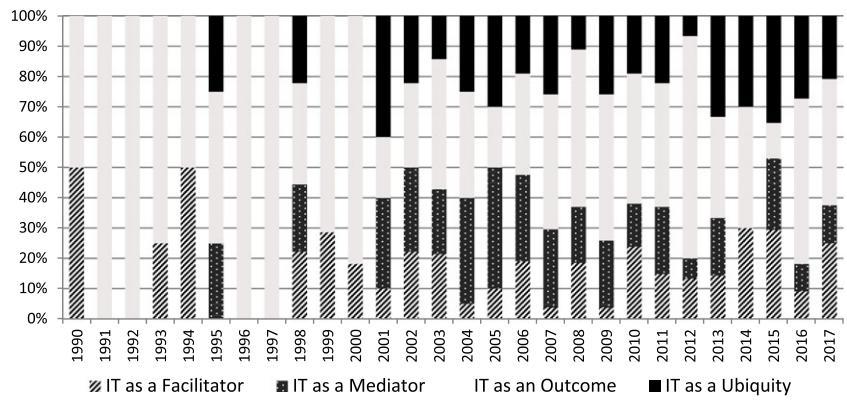


FIGURE 4 Development of the four roles of IT over time. IT, information technology

Finally, and maybe the most interesting patterns are shown in research on digital start-ups. First, researched variables and paths seem to be more interrelated than for the other types. This responds to the inherent nature of this type where entrepreneurs need to balance many interacting parts of their businesses (El Sawy, Malhotra, Park, & Pavlou, 2010). Extant literature has argued that the performance of digital start-ups is often related to their capabilities of designing and managing a community of users for high participation. This directly connects to the challenge of reaching critical mass for business models that exhibit network externalities, which is very common for this type of new venture. Another important key to success has been identified with the technical and organizational capabilities to develop an open ecosystem enabling third-party developers to add valuable features.

5 | AN AGENDA FOR IT-ASSOCIATED ENTREPRENEURSHIP RESEARCH

First, we take a deeper look at future research opportunities pertaining to the different start-up types that we developed. The ideas are constructed from the insights we gained during the review and are specifically tailored to each role of IT and its competitive value creation and capture. Following Xiao et al. (2013), these specific research ideas are succeeded by general reflections on the gaps in existing literature.

We argue that start-ups are significantly different, and therefore, existing research on established firms can only serve as a starting point. These differences are explained by the well-established liability of newness and liability of smallness concepts that put forward several dimensions of differences (Stinchcombe, 1965). First, new ventures usually have very limited resources and almost no organizational slack to support their product innovation, operations, or longer change processes. Second, their teams, roles, and structures mostly are less formalized, specialized, and routinized. Third, social ties as well as connections with collaboration partners are less pronounced due to missing organizational legitimacy, which makes acquiring these or other resources much more difficult. And finally, established firms have acquired a lot of product, process, customer, and market knowledge, which is uncommon for start-ups exploring new ideas (Abatecola, Cafferata, & Poggesi, 2012; Su, Xie, & Li, 2011). Furthermore, entrepreneurship literature has conceptualized several phases that new ventures undergo until they become established and stable. Importance of the dimensions is shown to change over time. While the focus of start-ups in the initial conception phase is on resource acquisition and technology development, the commercialization phase is dominated by production start-up and organizational development (Kazanjian, 1988). These specifics should be taken into account when relying on articles on established firms that we cite as starting points for future research below.

5.1 | Research ideas for the different types of IT-associated start-ups

The following discussion outlines topics for an agenda of IT-associated entrepreneurship research. Topics are clustered based on the start-up types and the different topics. The most interesting objects are sorted first (or marked with +++) in our textual descriptions below and also in the tabulated overview (see Table 5).

5.1.1 | Future research on digital start-ups

Specifics of this start-up type

Digital start-ups are defined as new ventures that use IT in the role of a *ubiquity*, meaning that they leverage completely IT-driven and digital business models for their value creation and capture. All three business model pillars (Osterwalder et al., 2005) are permeated by IT. These ventures use infrastructure management resources that are driven by IT; their customer interface regarding the ordering and delivery of the product or service is completely based on IT-mediated networks; and the value-creating product is a digital product or service (Bradley, Kim, Kim, & Lee, 2012; Huang & Sundararajan, 2010). Following the configurational suggestions by El Sawy et al. (2010), digital start-ups face highest complexity in configuring all different but interacting parts of their business models due to the inherent features of ubiquitous IT that usually bring a digital ecosystem to be managed. For example, changes in

TABLE 5 Overview of the agenda for information technology (IT)–associated entrepreneurship

Topic		Digital Start-ups	IT-mediated Start-ups	IT-facilitated Start-ups	IT-bearing Start-ups
Analysis of the transition process to another IT role		• Transition from IT-bearing start-up to digital start-up • Transition from IT-mediated to digital start-up	• Transition from IT-facilitated to IT-mediated start-up • Transition from IT-bearing to IT-mediated start-up	• Transition from non–IT-associated start-up to IT-facilitated start-up	• Transition from IT-facilitated to IT-bearing start-up
Value creation/ competitive advantage		Research on competitive challenges that are typical for this start-up type (digital products or services, IT-mediated sales and logistics, and network externalities): • Overcoming the chicken-and-egg-problem with scant resources • Managing privacy (and how does this connect to network externalities?) • Securing digital products from imitation and copying • Managing and capturing user-created value	Research on competitive challenges that are typical for this start-up type (physical products or services and IT-mediated sales channels): • Establishing effective IT-mediated sales channels • Making multichannel choices • Making location choices	Research on competitive challenges that are typical for this start-up type (IT-facilitated operations): • Improving performance of primary activities through IT • Making IT investment decisions	Research on competitive challenges that are typical for this start-up type (IT-based product or service): • Inventing or improving products or services • Managing the development cycles of products or services • Making outsourcing decisions
Outcome Variables		• Users/sign-ups • Patents/survival • Business model management/ innovation • Economic outcomes	• Orders • Usability • Page views • Employee growth • Economic outcomes	• Pricing/cost/ margin • Market value • Adoption/use • Internal user satisfaction • Economic outcomes	• Product innovation • External user satisfaction • Standardization/ use of standards • Economic outcomes
Theoretical Perspectives		• Network externalities • Resource-based view • Service-dominant logic	• Process virtualization • Social capital theory • Actor-network theory	• Task-technology fit • Diffusion of innovations • Process virtualization	• Dynamic capabilities • Entrepreneurial agility • Transaction cost theory
Application of the business model concept	As a unit of analysis	+++	++		++
	Sampling and grouping	+++			
	As a template	+++	+++	+++	+++
	As a result	+++	+		+

the digital product or service can induce changes to used IT systems for production, to customer interaction channels as well as in user behaviour that needs to be managed within the entire digital ecosystem. This makes the situation even more "messy, complex, and chaotic" (p. 835) as it is combined with features of the liabilities of newness and smallness (eg, missing specialization and legitimacy) that such start-ups are facing (Abatecola et al., 2012; El Sawy et al., 2010).

Our review has revealed that digital start-ups are one of the least researched types of new ventures. They are also the phenomenon that has been studied for the shortest period, and progress is seen only in recent years (see Figure 4). This makes them a good focus for future research. Therefore, we want to highlight some ideas in this domain that are based on the insights uncovered during the review. We also present an overview of these ideas in Table 5, where the most interesting elements have been sorted to the top and left.

Analysis of the process of transitioning to this start-up type

We found very limited existing research on the processes by which start-ups transition between the different types and roles of IT. Because such transitioning is very common in entrepreneurial endeavours, it might be worthwhile to investigate how IT-bearing start-ups or IT-mediated start-ups can successfully shift their operations and business models to become digital start-ups, as this knowledge might enhance their value creation logic (Zott & Amit, 2017). These two types—IT-bearing and IT-mediated start-ups—appear to be the most common candidates for this shift, as IT-bearing start-ups might transfer their on-premises software products to a cloud service, or IT-mediated start-ups might switch to selling and delivering digital products or services instead of physical ones. The blockchain fosters this trend in several areas, for example, via smart contracts (Beck, 2018). A starting point for this type of research might be found in existing literature on digital transformation of established firms, for example, digital transformation strategies (eg, Matt, Hess, & Benlian, 2015), pricing of digital goods (eg, Bradley et al., 2012; Huang & Sundararajan, 2010), or configuration theories for digital ecodynamics (eg, El Sawy et al., 2010).

Value creation and competitive advantage research

Starting a new digital venture—or shifting to this type of venture—always creates several challenges that are inherent to the associated value chain configuration. For example, due to network effects and the chicken-and-egg problem, digital start-ups often face the need to reach critical mass quickly when entering a market. However, how can this be accomplished given the scarce resources available and lack of experience with an unknown product or service? Such questions could be investigated using, as outcome variables, the number of users or new user sign-ups for start-up offerings. The economic theory of network externalities can frame such research. Morse, Fowler, and Lawrence (2007), as an article from our review, have started this avenue by theorizing virtual embeddedness through interorganizational electronic connections and its potential to decrease liabilities of newness. However, they stay on the conceptual level and do not offer empirical validation. Another interesting topic that is closely linked might be the management of privacy in social network sites and the effects on the speed of reaching critical mass.

Protecting digital products and information products from imitation or copying in combination with the challenges of liability of newness (Stinchcombe, 1965) is also a key element of success as a digital start-up. Blockchain technology might be a facilitator to this end (Beck et al., 2017). Analyses might be framed by using the resource-based view, which theorizes the inimitability, scarcity, and nonsubstitutability of resources (Barney, 1991). Potential variables to use in elaborating on such settings could be patenting and firm survival analysis. There is a large body of research on the resource-based view in the IS discipline[3] as well as on the liability of newness in entrepreneurship.[4] However, to the best of our knowledge, no one has combined these streams so far for digital start-ups beyond the typical patent studies that usually do not connect well to the inherent characteristics of digital products and information.

[3]For an overview, see Wade and Hulland (2004).

[4]For an overview, see Abatecola et al. (2012).

One of the main differentiators of digital start-ups is the very common inclusion of users as a part of the value creation logic (eg, YouTube). However, how should such start-ups attract and manage these user contributors with limited resources? How can this be a viable business? How can value be captured if it is created by another party outside the boundaries of a firm when there is no real formalized and established organizational framework in place? Taking into account the challenges of liability of newness as well as complex interactions between the different business model elements, the existing literature on value co-creation in established firms might be a good starting point here (eg, Huber, Kude, & Dibbern, 2017; Sarker, Sarker, Sahaym, & Bjørn-Andersen, 2012).

Further general ideas for this start-up type

Among the articles that focus solely on digital start-ups, no traditional multilevel studies have yet been published, even though this is a common approach in entrepreneurship research and has been emphasized as important (Busenitz et al., 2003; Low & MacMillan, 1988). For instance, a study might focus on the individual level and elaborate on the personal network ties of a founder and their impact on his or her entrepreneurial intentions. Additionally, network ties might also have multilevel impact, for example, on the performance of a new venture. Given that founder teams are very important (Häsel, Kollmann, & Breugst, 2010) but scarcely researched for digital start-ups, one promising avenue for future research could be founder team characteristics (eg, what are the levels of IT or marketing competencies in the founder team?) and their impacts at the firm level (eg, crowdfunding performance). Resource-based theoretical perspectives are the predominant perspective used in existing studies; hence, a different set of theories might be of interest to explain crowdfunding performance. Examples include impression management theory (Lim, Benbasat, & Ward, 2000; Schlenker, 1980) and team heterogeneity (Zimmerman, 2008). Furthermore, case studies are the most common methodology used to investigate digital start-ups; yet, looking at initial coin offerings or traditional crowdfunding markets will render secondary data or experiments interesting (Hoegen, Steininger, & Veit, 2017).

Using the business model of digital start-ups as a level of analysis, researchers might consider any of the following questions: How do business models based on recurring revenues impact the market entry success of new ventures? How do entrepreneurs find their way to a sustainable business model in markets where user numbers are seen as the most important indicator of success? How does business model configuration in such settings impact the funding performance of digital start-ups? Promising theoretical perspectives for investigating these questions might be found in the economic theory of network effects (Katz & Shapiro, 1985) or first mover theory (Gal-Or, 1985). Focusing on technological outcome variables, it might be interesting to investigate the following question: How do entrepreneurs whose business models rely on the heavy traffic of large user bases successfully manage their infrastructure? One example of a seldom-used methodology in digital start-up studies is ethnography, which could be an appropriate approach for investigating this question.

5.1.2 | Future research on IT-mediated start-ups

Specifics of this start-up type

Information technology–mediated start-ups are defined as start-ups that use IT in the role as a *mediator* in their entrepreneurial operations. This means that they leverage IT mainly in the infrastructure and customer interface pillars of their business models, with the purpose of reaching their clients via computer-mediated networks (Osterwalder et al., 2005). This increases, for instance, the complexity when adopting a new technology or system in one of the pillars as it needs to be integrated with IT in the other pillar to leverage its full potential. Complexity and interactions are fostered further by fluid organizational structures and business logic. In our review, we found that IT-mediated start-ups are one of the least researched types of new ventures, which makes them a good focus for future research.

Analysis of the process of transitioning to this start-up type

Two typical transitions can be seen as rather common for this type: The transition of either IT-facilitated or IT-bearing start-ups to IT-mediated ones. Both might make this transition by developing an IT-mediated sales channel.

However, how can this be managed successfully with the scant resources of a start-up? Investigating this topic from the liability of newness perspective in general, the literature stream on e-commerce adoption in established firms might be a good starting point. Furthermore, we found one article in our review that looks at the transitioning process from IT-facilitated to IT-mediated which can serve as the groundwork. However, the authors only look at one failing case without specifically theorizing the liability of newness.

Value creation and competitive advantage research

Information technology–mediated start-ups use IT-mediated channels to reach their customers and receive orders. It is therefore particularly important to understand how such a channel can be set up and managed effectively and what other types of channels should also be offered. The blockchain technology provides new and interesting ways to digitalize elements that needed a physical channel before (eg, contracts) by ensuring trust also between parties that are unknown to the market place and have no established brand yet (Beck, 2018). If other channels are offered, how are they compatible and how should they interact? This could be analysed using orders or usability, as well as channel returns, as outcome variables. Process virtualization theory (Overby, 2008) might frame such research. The business model concept could serve as a template for how to align IT and channels.

Further general ideas for this start-up type

Another example of an interesting avenue for research at the sparsely studied societal or regional levels could be the impacts of IT-mediated start-ups on local retailers in a city. A potential theoretical approach for framing such research might be population ecology theory (Hannan & Freeman, 1977). Secondary data analysis is frequently used in such theoretical framings, where the dependent variable is often market entry/exit or survival.

From the viewpoint of the level of analysis, business model configurations of IT-mediated start-ups also present an interesting avenue for analysis: How does funding performance change based on different business model configurations (eg, subscription model versus advertisement model; Clemons, 2009)? An uncommon yet fruitful theoretical lens for this question might be management fashion theory (Abrahamson, 1991). Experimental research approaches enable the controlled changes of business model configurations and the analysis of associated impacts.

The product level is also open for future research: How can new IT-mediated start-ups handle and manage large numbers of product data features through the use of crowdsourcing approaches? Can they potentially ensure trust via blockchain technology if giving mission-critical work to an anonymous crowd (Risius & Spohrer, 2017)? Entrepreneurial bricolage theory (Baker & Nelson, 2005) might frame a case study research design to address this question.

5.1.3 | Future research on IT-facilitated start-ups

Specifics of this start-up type

Information technology–facilitated start-ups are defined as start-ups that use IT only as a facilitator of their entrepreneurial operations. This means that they leverage IT mainly in the infrastructure pillar of their business models to enhance efficiency of their operations (Osterwalder et al., 2005). From a configurational viewpoint (El Sawy et al., 2010), this is the least complex set-up since there are little interactions of IT because it is only used in the supporting activities of the value chain. We found that IT-facilitated start-ups are the third least-researched type of new venture in our review. Nevertheless, there is still room for further research on IT-facilitated start-ups.

Analysis of the process of transitioning to this start-up type

One common path that might be of interest for future analysis is the process by which non–IT-associated start-ups transition to IT-facilitated ones. This transition is mainly accomplished by introducing new IT into the entrepreneurial organization. However, where should performance-enhancing IT be introduced and how if there are neither formalized structures nor a stable product or business model in place? What is specific to new ventures when they adopt IT from a liability of newness perspective, and how does this impact their performance or survival? Maybe adoption is

much easier and follows other patterns due to missing formal structures, roles, and work routines? Leveraging the established research streams of adoption and use from the IS discipline (eg, Venkatesh, Morris, Davis, & Davis, 2003) as well as growth stage models (eg, Kazanjian, 1988) and liability of newness specifics (eg, Short, McKelvie, Ketchen, & Chandler, 2009) from entrepreneurship seems interesting here. Whitley (1999) is one of the authors in our review that looked at a food start-up introducing an IT system from a participative viewpoint. This article can be a foundation for future research in this area.

Value creation and competitive advantage research

Information technology–facilitated start-ups use IT in their infrastructure management to optimize the performance of their primary value creation activities. Hence, it will be interesting to understand which activities should be facilitated by IT in such start-ups, how they should be facilitated, and where to invest scarce resources. Combining this with a focus on different development stages (Kazanjian, 1988) of start-ups might be of value here. These topics could be approached through analyses of the margins between such start-ups or market valuation as outcome variables. Task-technology fit (Goodhue, 1995) or the diffusion of innovations theory (Rogers, 2003) could focus this research. The business model concept can be leveraged as a template to align value-creating activities and IT.

Further general ideas for this start-up type

The business model was very seldom used as the level of analysis in studies of IT-facilitated start-ups; hence, future research might consider the following question: How does IT adoption in an IT-facilitated start-up change the start-up's business model over time? One potential theoretical perspective to elaborate on this question might be the business model innovation literature (Chesbrough, 2007). Approaching the question through ethnography could also enable deep theoretical insights into the processes shaping entrepreneurial business models over time. This approach connects well with the small number of process theories developed in existing articles.

Few studies have been conducted at the levels of individuals or teams, and focusing on these levels can also generate stimulating research questions, such as "how do the IT competencies and contexts of entrepreneurs/teams impact their choice of business models"? Computer self-efficacy theory (Compeau & Higgins, 1995), as well as social capital theory—which is often used for research on the other roles (Coleman, 1988)—could be interesting lenses through which to study this question. Potential methods for this investigation include choice experiments with entrepreneurs or secondary data analyses.

Lastly, we want to highlight the importance of entrepreneurial information search. Entrepreneurs need to make quick decisions with high uncertainty in often unknown markets. This leads them to constantly search for information on their markets, products, and hypotheses. Online search, social media, and digital archives or news bulletins are exemplary resources for this search. How do entrepreneurs use these information sources? How does this data influence entrepreneurs' decision-making on product features or business model changes? These might be valuable questions that could be investigated with experiments or ethnographic observations, informed by perspectives such as behavioural decision theory (Simon, 1959).

5.1.4 | Future research on IT-bearing start-ups

Specifics of this start-up type

Information technology–bearing start-ups are defined as start-ups that use IT as an *outcome* of their entrepreneurial operations. These start-ups also leverage IT in their infrastructure management pillar, but IT is at centre of their business models and resides in the product pillar (Osterwalder et al., 2005). Hence, developing IT software or hardware and quickly adapting it to new insights into the unknown marketspace is at the centre of their focus, at least in the conceptual stage of the endeavour (Kazanjian, 1988). As pioneering new and unknown products or services can involve constant severe shifts in requirements but also the product itself, agility in IT product development becomes the key for such ventures. Research on agility in software teams of established firms can therefore be a valuable

starting point (eg, Lee & Xia, 2010; Sarker & Sarker, 2009). Research has mostly looked at software development on a team level while in start-ups, the team of developers frequently equals the new venture organization enabling other types of analyses on firm level impacts. From a configuration perspective, changes in the product pillar can require changed and specialized IT knowledge and/or new resources that might be challenged or enhanced by the features of liability of newness. We found that most existing literature focuses on IT-bearing start-ups. Still, there remains space for future investigations.

Analysis of the process of transitioning to this start-up type

We argue that shifting from another type to an IT-bearing start-up is one of the less common paths. However, it has occurred in the past and, for example, the Internet of Things and Industry 4.0 trends push the development. From this perspective, it might be of interest to learn how and why a start-up decides to follow this path and how the transition can be managed successfully with little resources at hand. Opportunity-seeking is one of the central themes in entrepreneurship (Short et al., 2010) and could be a stimulation to investigate how and why entrepreneurs chose to pursue this transition and become IT-bearing start-ups. The process of becoming such a start-up involves heavy reorganization of work force by hiring developers and engineers as well as merging with new work cultures of IT people now being in charge of the main value creation process. While established firms are able to address such shifts by using their slack resources to hire experienced developers (eg, car manufacturers hire developers from Google), this is not an option for start-ups with little resources and reputation.

Value creation and competitive advantage research

Information technology–bearing start-ups are mainly concerned with creating and inventing (ie, bearing) IT-based products or services. It is therefore of particular interest to understand how such innovations—and the development of IT-based products or services—can be managed successfully. This also involves outsourcing and other decisions. Outcome variables might be innovations as well as decisions or economic indicators. Theoretical frames for analysing outsourcing processes can be found in the dynamic capabilities theory (Teece, Pisano, & Shuen, 1997), the entrepreneurial agility theory (Doz & Kosonen, 2010), or transaction cost economics (Williamson, 1981). The business model concept can be used as a template to align the different activities. For many IT-bearing new ventures, software development practices are central to their product, which also makes this an interesting field for investigation. Valid questions in this area include the following: Should developed products be based on standardized open source components? How can software-based start-ups with scant resources establish successful strategies for hiring enough software developers? Looking at a very special type of new software ventures, Gruber and Henkel (2006) started this stream by investigating the innovation and product development mechanisms of open source software start-ups.

Further general ideas for this start-up type

Even if this type has been researched rather extensively, Table 3 still reveals compelling and scarcely researched areas within this stream. In particular, the business model is seldom used as a level of analysis and has the potential to highlight such questions as: How do IT-bearing start-ups adapt their business models to fast-changing technologies and markets? Entrepreneurial agility theory could build a theoretical scaffolding to enable deep contextual and processual insights using case studies.

At the product level of analysis, software development processes within IT-bearing start-ups could be a compelling research area: How can these start-ups use scant resources to build products that successfully compete with the output of large software companies? Work systems theory (Alter, 2013), together with the sparsely used action research approach, can help to frame this investigation.

Turning to the group/team level, elaborating on the funding or financial performance of IT-bearing start-ups, with a focus on the impact of their founder's teams' formal and informal IT competencies is another promising area of inquiry. Agency theory (Alchian & Demsetz, 1972; Jensen & Meckling, 1976) can help to understand these impacts, and a choice-based experimental setting could be particularly illuminating.

5.2 | General reflections on theories for future research

Some very well-known and general theories (eg, resource-based view and institutional theory) are heavily represented in existing work. However, we envision that bringing more discipline-specific theories into this interdisciplinary research stream could enable the next stage of investigations on the topic.

The IS discipline offers numerous theoretical lenses that can be used to study IT-associated ventures. One example is task-technology-fit theory that can be a fruitful perspective from which to elaborate on the topic. Media richness theory (Daft & Lengel, 1986) can also inspire future work, as it explains how uncertainty and equivocality impact information processing and communication effectiveness.

An example from entrepreneurship is the theory of entrepreneurial bricolage (Baker & Nelson, 2005), which explains how entrepreneurs find their way using intuition and minimal resources. This theory could help illuminate the dynamic business model development processes of founders with scarce resources, for instance. Entrepreneurial agility (Chakravarty, Grewal, & Sambamurthy, 2013) could build a different perspective on similar questions. Other interesting entrepreneurial perspectives include the lean start-up approach (Ries, 2011) and opportunity recognition theory (Shane, 2000).

Within the general management discipline, theories such as social network theory (Granovetter, 1973), social capital (Coleman, 1988), or top management team diversity (Hambrick, Cho, & Chen, 1996) might enable fruitful insights. We would like to particularly highlight social network theory. Not only is it a theoretical framework but it also offers methodological techniques for understanding a person's strong and weak ties and the impacts of these ties. The plethora of information available online about social networks (eg, Facebook friends, Twitter followers, or LinkedIn contacts) enables the analysis of such ties.

5.3 | General reflections on methods for future research

Methodologies cannot vary completely and are sometimes bound to specific settings or theories. Nevertheless, we would like to encourage scholars interested in IT-associated entrepreneurship to focus not only on ethnographies, experiments, action, and design research but also on the use of surveys, which have been used surprisingly rarely in existing research.

Ethnographies usually rely on an interpretive paradigm, which is also used rather sparsely in existing research on IT-associated entrepreneurship. We see ethnographies as a potentially fruitful avenue for gaining a deep understanding of entrepreneurial processes through immersion. Examples of such processes might be the formation process of new ventures, or the learning process that a new venture's team follows to find a viable business model. Experiments are also used very seldom in existing work, but they allow the scholar to establish clear causalities by controlling all variables and treatments. An example could be conducting experiments with investors who elaborate on their funding intentions based on varying business model configurations. Individual- and team-level research on the skill sets and characteristics of digital entrepreneurs, for example, might be particularly well suited for survey-based methods. These results might enable further studies on business model development by the founders (team), as well as studies of their entrepreneurial intentions.

5.4 | General reflections on outcome variables with a focus on the business model

Use of the business model as a dependent variable was seldom found in existing research. Its use as a dependent variable might take on various forms. Business model choice or innovation/change is one way this type of dependent variable could connect to the stream of literature on business model innovation in existing firms (Casadesus-Masanell & Zhu, 2013; Chesbrough, 2007). Entrepreneurial firms typically experiment to find a sustainable business model (Sosna et al., 2010). Yet few articles have investigated this process.

Data availability is always a challenge, especially for scholars investigating start-ups, as the objects of investigation are usually young and small with little data available. This is, on the one hand, fostered by start-ups that are often

trying to stay under the radar for a longer time until they are ready to make a strong entrance into a market. On the other hand, many countries have regulations that allow small and young firms to keep annual reports private, in contrast to larger firms that are often obligated to disclose business data regularly (eg, for initial public offerings).

During our review, we collected a large number of secondary data sources, most of which are performance/outcome related. An overview of the most interesting ones is presented in Appendix C, together with examples of how the specific data source was used in an article of the literature review. We hope that this collection might be useful for scholars in the field. However, we would also like to encourage future researchers to develop new performance variables, especially ones that focus specifically on IT-mediated and digital start-ups. We believe that the current availability of large data pools can support these endeavours, for example, with Google search trends, sentiments on social networking sites, or user visit times for specific pages (Choi & Varian, 2012; Wu & Brynjolfsson, 2009).

6 | CONCLUSION AND CONTRIBUTIONS

Following a systematic approach, we reviewed and mapped 292 articles of IT-associated entrepreneurship research in IS, entrepreneurship, and general/strategic management to achieve the objectives of this article. We have crafted our review to ensure best possible outcomes. However, our results do not come without limitations. For example, we have done our best to carefully extract information from the articles. For the few remaining articles where there was further clarification needed, we had two coders discuss the ambiguous elements as suggested in other studies (eg, Strong & Volkoff, 2010). Nevertheless, there still might be some interpretation involved on our side (Dibbern et al., 2004). Hence, the exact numbers of articles per type shall be rather seen as trends. These limitations should be kept in mind when interpreting our contributions that are threefold.

First, we aimed to provide an overview and categorization of existing research in the field. Our review results are structured to build a foundation for IT-associated entrepreneurship research, and they allow comparisons between the different patterns that have been discussed throughout this article.

Second, we wanted to clearly define IT-associated entrepreneurship research, its scope, and related start-up types with their business models. Because the field is still very young and interdisciplinary in nature, the existing definitions (if any) are blurry. We analysed the role of IT in the study sample of firms to build a solid basis for definitional work. The patterns resulting from this analysis showed that IT take on four diverse roles for entrepreneurs: (1) IT can be a *facilitator* for entrepreneurial operations by supplying tools and systems (eg, computers, software such as ERP); (2) IT can act as the *mediator* for entrepreneurial operations, enabling IT-mediated channels to customers (eg, e-commerce); (3) software, hardware, and IT services can also be the *outcome* or product of entrepreneurial operations (ie, software, hardware, or IT services as the goods produced by a new venture); and (4) IT can constitute a *ubiquity* by infiltrating all elements of the business model and entrepreneurial operations (eg, digital platform start-ups such as Airbnb).

On the basis of these insights, we suggested four definitional types for entrepreneurial ventures and their business models. In each of these types, IT is used on a different level (see Table 4 for an overview of the definitions). We see these definitions as a contribution to clarifying the existing confusion that surrounds these definitions. Furthermore, distinguishing among the four types—(1) *IT-facilitated start-ups*; (2) *IT-mediated start-ups*; (3) *IT-bearing start-ups*; and (4) *digital start-ups*—can help future research to better address and analyse the specifics of each type through a deeper understanding of the role of IT. Within each type, we have therefore elaborated on the differences in the value creation logic and the role of IT.

Such typologies have been identified as being important, especially in emerging fields (Wolf, 1926), because they will not only allow the choice of theoretical lenses or methods particularly tailored to the settings of a type but also enhance sampling, allowing scholars to better generalize and uncover opposing effects between the types (Al-Debei & Avison, 2010; Lambert, 2015). To the best of our knowledge, there were no typologies existent specifically for start-ups and their business models from an IT perspective. This is one of the gaps that we try to fill with our developed types.

Third, IT-associated entrepreneurship has dominated economic development in recent years and will continue to play a major role. However, a large percentage of new ventures fail, particularly in the field of IT-associated start-ups (Hathaway, 2013; Singh et al., 2007; Timmons, 1994). Keeping in mind the strong impacts of these new ventures, we constructed an agenda to further stimulate research in this emerging field. New ventures often need to shift their focus many times on their way to finding a profitable business logic (Baker & Nelson, 2005). We therefore placed particular emphasis on the interesting transition processes that occurred between the different roles and types during the creation of our agenda. We hope that our review, definitions, and research agenda will stimulate rich interdisciplinary research and publications on this topic.

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APPENDIX A. ARTICLE IDENTIFICATION

The first round of searching in the set of journals was performed on a broad basis to avoid missing any important contributions. We used carefully crafted keywords to identify an initial long list of 2389 articles (Ireland, Reutzel, & Webb, 2005). Our approach was twofold: We queried the IS and GSM journals for entrepreneurship terms such as the following: *entrepren**, *startup*, *start-up*, "*new venture*," "*new firm*," "*young firm*," *founder*, *founding*, *founded*, "*venture capital*," "*Initial Public Offering*," and *IPO*. The entrepreneurship journals were queried for IS terms, such as "*information technology*," "*information technologies*," "*information system**," *internet*, *web*, *net*, *online*, *digital*, *digitized*, *digitalized*, *electronic*, *virtual*, *computer*, *software*, *hardware*, *mobile*, and *app*.

We started by querying the search engines on the websites of each individual journal (ie, to capture articles in all timeframes as well as "online first" articles) where possible. Additionally, we consulted databases such as *EBSCO Business Source Premier*, *ScienceDirect*, or the *Wiley Online Library* if required (Xiao et al., 2013). The lower boundary of our timeframe was defined as the year 1990, and queries were updated until November 2017, including available online-first articles.

Two independent reviewers then screened the titles, abstracts, introductions, and results of the articles for inclusion or exclusion. If additional information was needed for inclusion or exclusion, we also reviewed additional sections, such as the study sample and findings sections. Our main reason for inclusion was if an article focused on new ventures and IT simultaneously (Leidner & Kayworth, 2006). Articles focusing on small- and medium-sized enterprises were only included if they gave specific details on the firm age of their samples and had a large portion of new ventures. For inclusion, we follow Kohli and Grover (2008), who define IT as a broader concept that covers not only hardware and/or software but also digital aspects. They argue that IT might become so strongly embedded and intertwined that it becomes indistinguishable from the outcome (ie, the product or service) and thereby ultimately can become a digital product or service. Editorials and calls for papers were excluded from the review. Agreement for inclusion between the reviewers was 94% (Holsti, 1969; Perkmann & Spicer, 2014; Wolfswinkel et al., 2011).

The resulting shortlist consisted of 268 articles. We carefully screened the references of these articles for additional papers that potentially matched our topic of interest (Webster & Watson, 2002). We thereby identified a second backward-searched longlist of 1171 articles. These were again screened for inclusion or exclusion, using the process mentioned above. Most of the articles had already been covered in our initial longlist. From the backward search, we ultimately ended up with an additional 24 articles that we deemed as relevant and added to our sample, bringing the final number to 292. Of these articles, 100 are derived from IS journals, 97 from entrepreneurship journals, and 95 from general and strategic management journals. Our further reviews, classifications, and analyses were all performed on this final sample.

APPENDIX B. REVIEW SYNTHESES DIAGRAMS

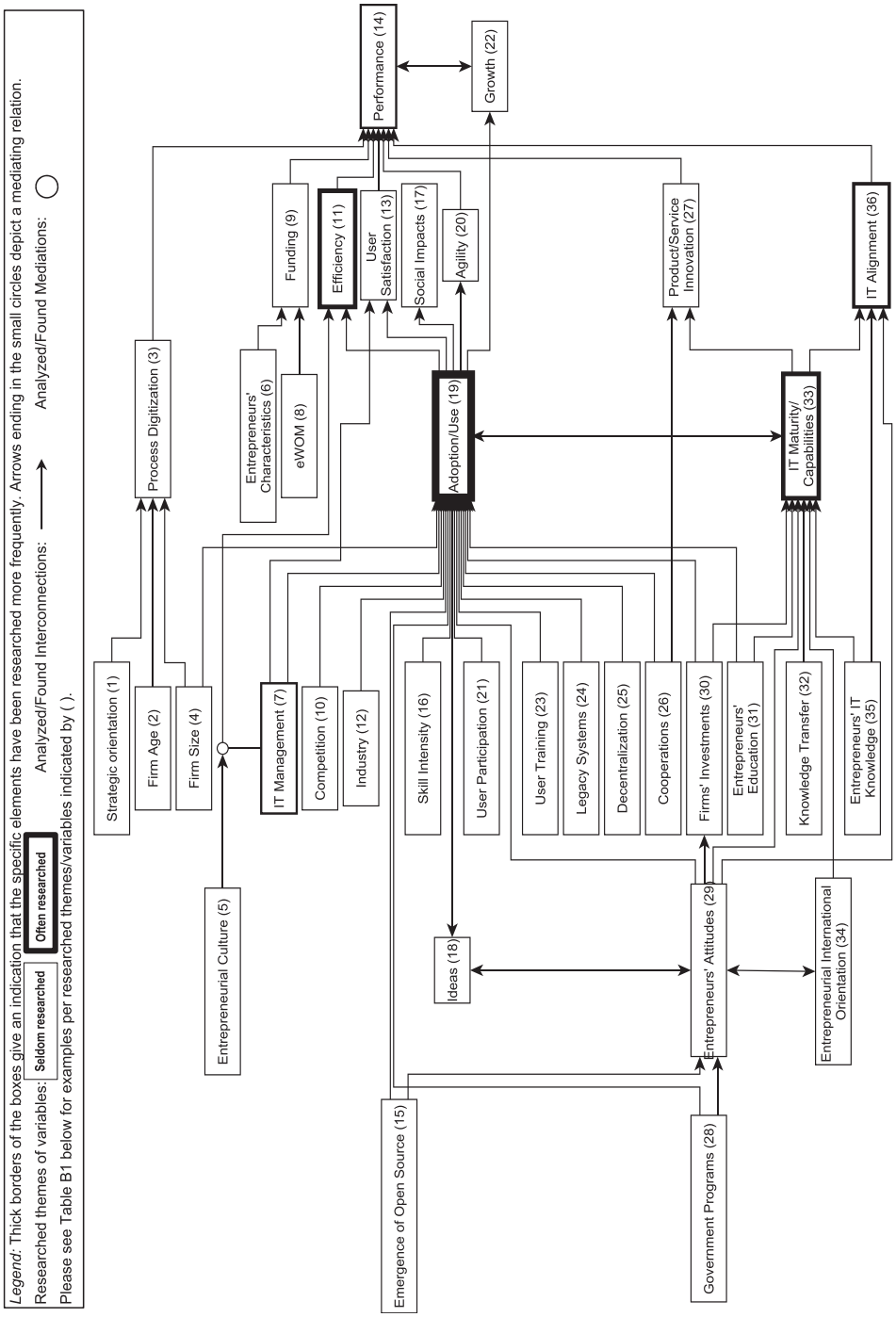


FIGURE B1 Synthesis of research findings for IT-facilitated start-ups

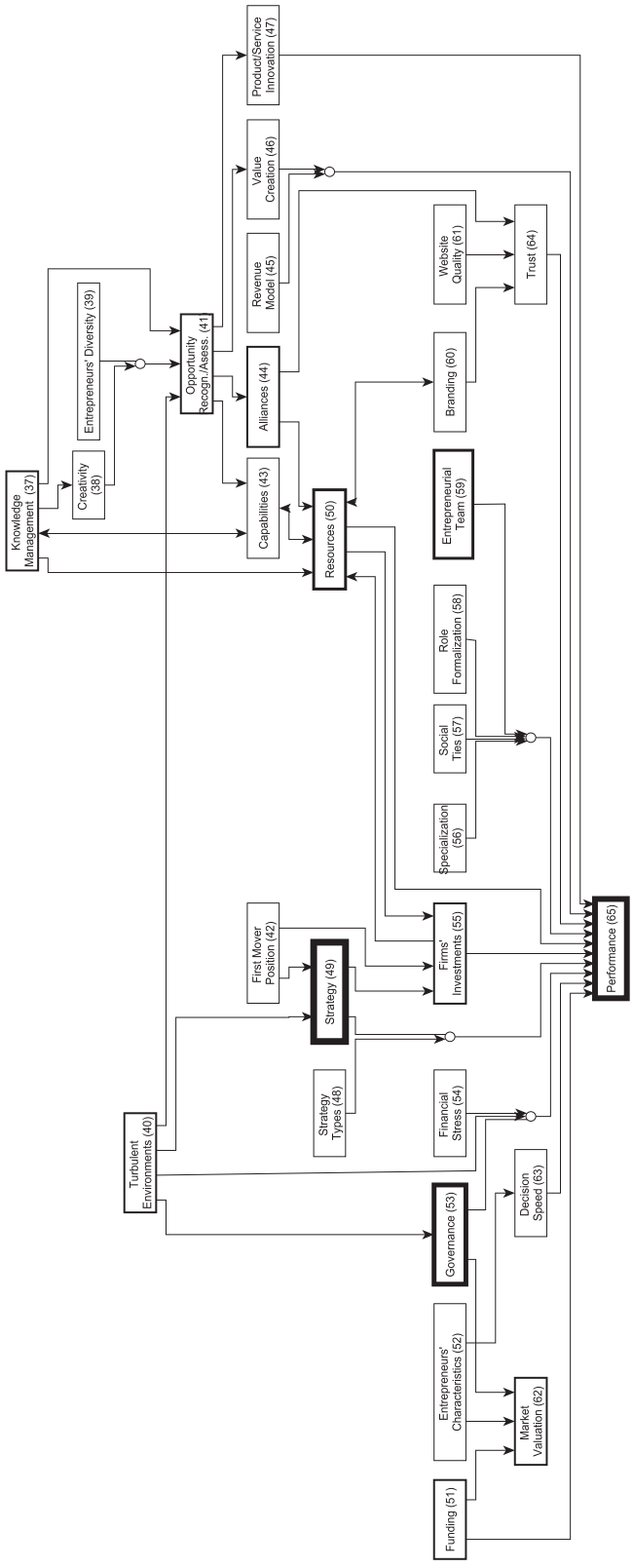


FIGURE B2 Synthesis of research findings for IT-mediated start-ups

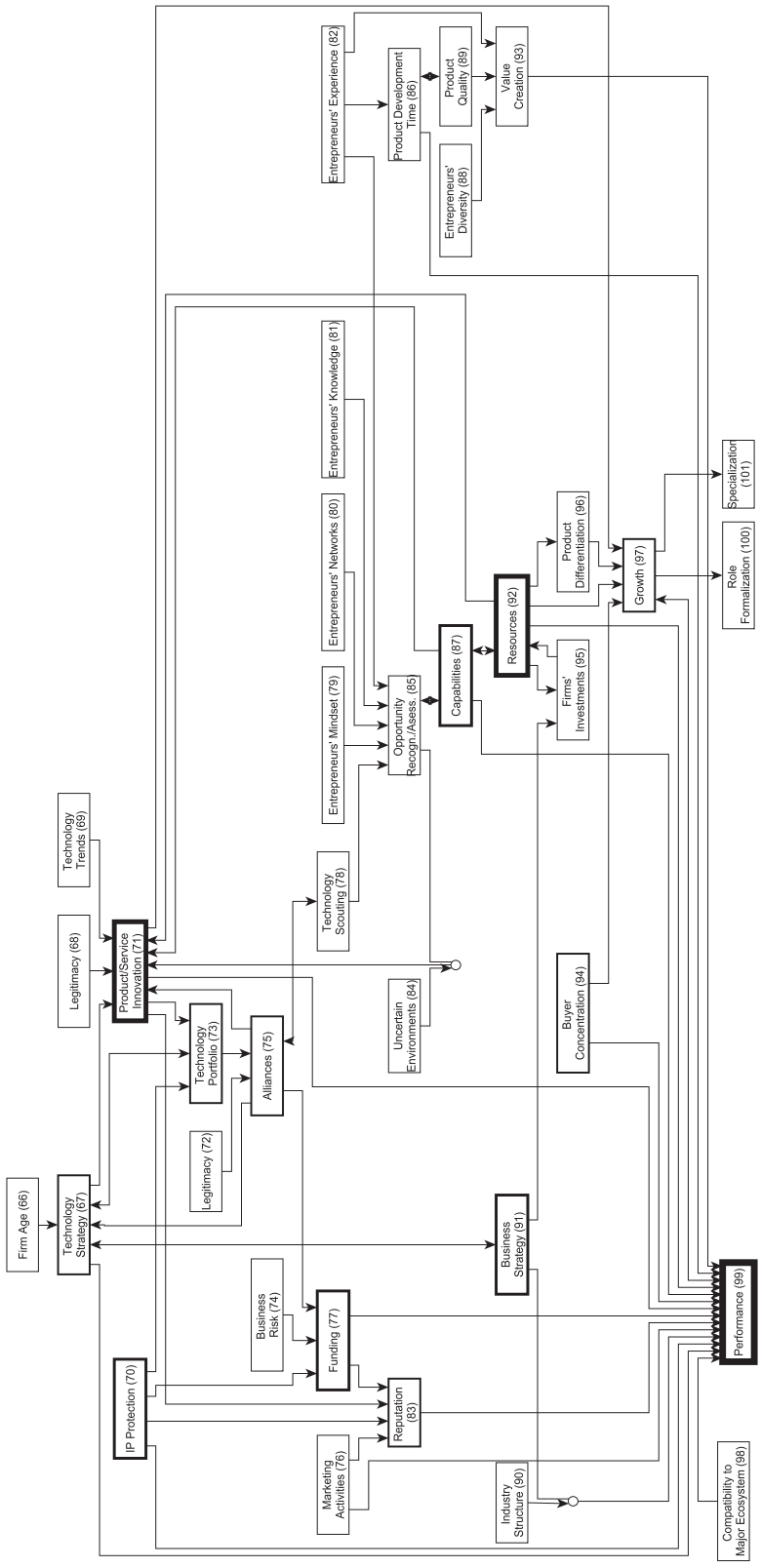


FIGURE B3 Synthesis of research findings for IT-bearing start-ups

APPENDIX C. SOURCES OF SECONDARY DATA FOR RESEARCH

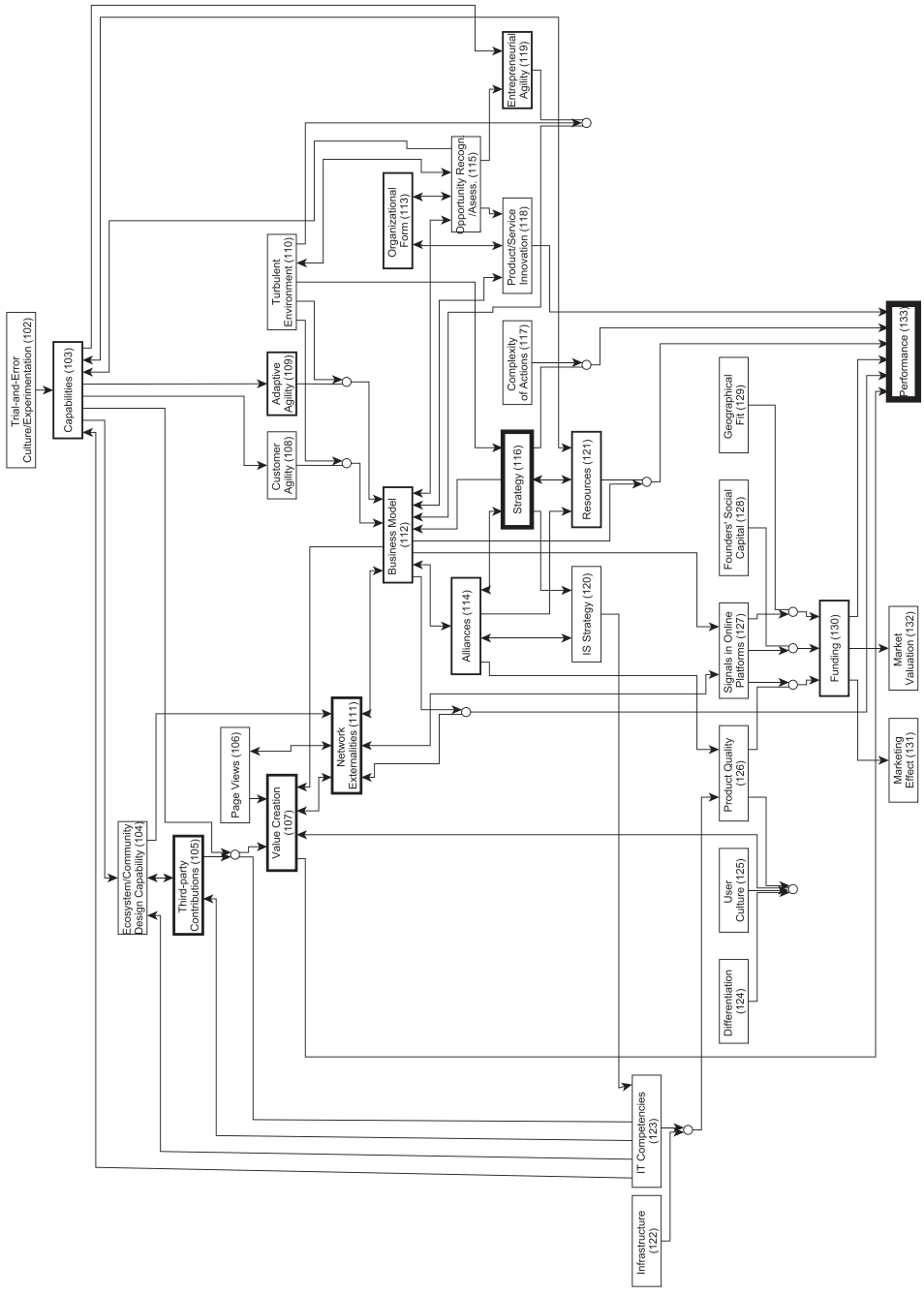


FIGURE B4 Synthesis of research findings for digital start-ups

TABLE B1 Example articles for Figures B1, B2, B3, B4 (indicated in parentheses)

1. BarNir, Gallaugher, & Auger, 2003
2. BarNir et al., 2003
3. BarNir et al., 2003
4. BarNir et al., 2003
5. Bradley, Pridmore, & Byrd, 2006
6. Younkin & Kuppuswamy, 2017
7. Caldeira & Ward, 2002
8. Aggarwal, Gopal, Gupta, & Singh, 2012
9. Aggarwal et al., 2012
10. Molla et al., 2006
11. Srivastava & Shainesh, 2015
12. Julien & Raymond, 1994
13. Caldeira & Ward, 2002
14. Sambamurthy, Bharadwaj, & Grover, 2003
15. von Krogh & Haefliger, 2010
16. Lal, 1999
17. Sandeep & Ravishankar, 2015, p. 2015
18. Välikangas & Sevón, 2010
19. Caldeira & Ward, 2003
20. Richardson, Banks, Kettinger, & Quintana, 2014
21. Whitley, 1999
22. Mutch, 1993
23. Richardson, Jackson, & Dickson, 1990
24. Richardson et al., 1990
25. Julien & Raymond, 1994
26. Srivastava & Shainesh, 2015
27. Lal, 1999
28. Vega, Chiasson, & Brown, 2008
29. Sambamurthy et al., 2003
30. Lal, 1999
31. Lal, 1999
32. Sambamurthy et al., 2003
33. Hussin, King, & Cragg, 2002
34. Zhang, Sarker, & Sarker, 2013
35. Hussin et al., 2002
36. Cragg et al., 2002
37. Kickul & Gundry, 2001
38. Kickul & Gundry, 2001
39. Kickul & Gundry, 2001
40. Kickul & Gundry, 2001
41. Kickul & Gundry, 2001
42. Eisenmann, 2006
43. Zahra & George, 2002
44. Park, Mezias, & Song, 2004
45. Clemons, 2009
46. Zahra & George, 2002
47. Kickul & Gundry, 2001
48. Kim et al., 2004
49. Kim et al., 2004
50. Park et al., 2004
51. Sanders & Boivie, 2004
52. Forbes, 2005
53. Dowell, Shackell, & Stuart, 2011
54. Dowell et al., 2011
55. Eisenmann, 2006
56. Sine, Mitsuhashi, & Kirsch, 2006
57. Avgerou & Li, 2013
58. Sine et al., 2006
59. Dowell et al., 2011
60. Lowry, Vance, Moody, Beckman, & Read, 2008
61. Lowry et al., 2008
62. Sanders & Boivie, 2004
72. Pollock & Rindova, 2003
73. Kelley & Rice, 2002
74. Dos Santos et al., 2011
75. Moghaddam, Bosse, & Provance, 2016
76. Pearce II & Michael, 1997
77. Mann & Sager, 2007
78. Kelley & Rice, 2002
79. West III & Meyer, 1997
80. Hallen, 2008
81. Beckman & Burton, 2008
82. Reuber & Fischer, 2009
83. Zahra & Bogner, 2000
84. McKelvie, Haynie, & Gustavsson, 2011
85. West III & Meyer, 1997
86. Khessina & Carroll, 2008
87. Lee, Lee, & Pennings, 2001
88. Beckman & Burton, 2008
89. Reuber & Fischer, 2007
90. McDougall, Robinson Jr., & DeNisi, 1992
91. McDougall et al., 1992
92. Katila, Rosenberger, & Eisenhardt, 2008
93. Rietveld, 2017
94. Lee, Bach, & Baik, 2011
95. Dowling & McGee, 1994
96. Giarratana, 2004
97. Abetti, 1997
98. Ceccagnoli, Forman, Huang, & Wu, 2012
99. Ceccagnoli et al., 2012
100. Kazanjian & Drazin, 1990
101. Kazanjian & Drazin, 1990
102. Koch, 2010
103. Tan, Pan, Lu, & Huang, 2015
104. Wessel, Thies, & Benlian, 2017
105. Gnyawali et al., 2010
106. Kauffman & Wang, 2001
107. Amit & Han, 2017
108. Koch, 2010
109. Chakravarty et al., 2013
110. Chakravarty et al., 2013
111. Kauffman & Wang, 2001
112. Ojala, 2016
113. Perkmann & Spicer, 2014
114. Currie & Parikh, 2006
115. Ojala, 2016
116. Currie & Parikh, 2006
117. Gnyawali et al., 2010
118. Doganova & Eyquem-Renault, 2009
119. Chakravarty et al., 2013
120. Tan et al., 2015
121. Amit & Han, 2017
122. Chakravarty et al., 2013
123. Chakravarty et al., 2013
124. Currie & Parikh, 2006
125. Hempel & Kwong, 2001
126. Currie & Parikh, 2006
127. Mollick, 2014
128. Mollick, 2014
129. Mollick, 2014
130. Berg, Neumann, & Rietz, 2009
131. Burtch, Ghose, & Wattal, 2013
132. Berg et al., 2009
133. Chakravarty et al., 2013

(Continues)

TABLE B1 (Continued)

63. Forbes, 2005
64. Lowry et al., 2008
65. Kim et al., 2004
66. Henderson, 1999
67. Zahra & Bogner, 2000
68. Kaganer et al., 2010
69. Pontikes & Barnett, 2017
70. Mann & Sager, 2007
71. Zahra & Bogner, 2000

TABLE C1 Overview of sources of secondary data in IT-associated entrepreneurship research

Data Source	Description (Example of Use)	Examples of Available Data
http://crunchbase.com	This website is the start-up database of TechCrunch. It is sometimes called the Wiki of tech–start-ups because it is open to editing, free, and known as the most comprehensive source available, with over 800 000 profiles. Includes details on start-ups. It also has an API to connect to its website via scripts. Example of use: Spiegel et al., 2016	• Start-ups (name, founding date, type, industry, social media profiles, location, description, number of employees, and URL) • Founders (name, birthday, degrees, experiences, social media profiles links, advisor roles, and founded companies) • Products (name, lifecycle stage, and product URL) • Funding rounds (number, dates, amounts, types of funding, and investors) • Acquisitions (price, date, and acquirer) • IPOs (date and capital raised) • News and press releases on the start-up (date, title, and text)
http://download.com	A website for downloading software applications. It has several statistics on downloads and page views. Example of use: Reuber & Fischer, 2009	• Number of downloads for a specific software • Number of page views for a specific software
Factiva	A database for news analysis with access to thousands of news and information sources on 22 million public and private companies. Example of use: Reuber & Fischer, 2007	• News on technologies • News on industries • News on companies • News and executives and founders
Hoover's	Contact details of companies by industry. Especially suitable for selecting survey participants within specific fields such as software companies. Example of use: BarNir et al., 2003	• Contact details of 85 million companies, founding dates, and managers • Key competitors • Selection by specific fields or 900 industries • Lists of IT leaders • Details on IT strategy, software, and platforms • Financials
NVCA Yearbook	"The NVCA Yearbook is an annual comprehensive analysis of US venture capital industry statistics." Example of use: Zacharakis, Shepherd, & Coombs, 2003	• Commitments made to venture capital funds • Venture capital investments into entrepreneurial companies • Venture-backed exits (mergers and acquisitions as well as IPOs) • Portfolio company valuation guidelines • Venture capital activity outside the United States
S&P Capital IQ's Compustat	One of the most comprehensive databases on financial performance and executive data.	• Financial performance data • Credit ratings

(Continues)

TABLE C1 (Continued)

Data Source	Description (Example of Use)	Examples of Available Data
	Example of use: Chaganti, Watts, Chaganti, & Zimmerman-Treichel, 2008	• Fixed income information • Filings • Ownership and investor activism • News • Transactions
SDC Platinum	Securities data corporation is a database for alliances, mergers&acquisitions, private equity etc. Example of use: Dushnitsky & Lavie, 2010	• Mergers and acquisitions transactions • Equity capital markets transactions • Public financings data • Project finance data • Joint ventures and repurchases • Shareholder activism: Detailed histories • Alliance formation
http://thomsonone.com (former VentureXpert)	Broad and deep range of financial, owner, and news content on companies. Example of use: Wagner & Cockburn, 2010	• Market quotes • Earnings estimates • Financial fundamentals • Press releases • Transaction data • Corporate filings • Ownership profiles • SEC documents