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The impact of Digitalization on Business Models: How IT Artefacts, Social Media, and Big Data Force Firms to Innovate Their Business Model

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The Impact of Digitalization on Business Models: How IT Artefacts, Social Media, and Big Data Force Firms to Innovate Their Business Model

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Abstract

Digital technology has forced entrepreneurs to reconsider their business models (BMs). Although research on entrepreneurial intention and business models is gaining attention, there is still a large knowledge gap on both fields. In this paper, we specifically address the impact of digitalization on business model innovation (BMI). Based on data collected from 338 European small- to medium-sized enterprises (SMEs) actively using IT artefacts, social media, or big data to innovate their business model, we study antecedents of BM experimentation and BM innovation practices, as well as overall business performance. We carried out four in-depth case studies of companies in which BM innovation is related to IT artefacts and more specifically to social media and big data. The findings from the quantitative study show that BMI is related to IT artefacts, social media, and big data. Use of IT artefacts, social media, and big data is mainly driven by strategic and innovation-related internal motives, although external technology turbulence plays a role too. BM innovation driven by IT artefacts, social media, and big data has an impact on performance. Although the case studies show that this is more evident for IT artefacts and big data than for social media.

Keywords: big data, business model innovation, digitalization, IT artefacts, social media

1. Introduction

Attention to business model innovation (BMI) is increasing both in entrepreneurial practice and in research (Zott & Amit, 2010). In this paper, we define the concept of business model as the business logic to create and capture value for both consumers and the business itself. In other words, it refers to the way a single organization or a network of firms collaborates on the strategic and operational levels to bring products and/or services (bundles) to the market. A single organization or a network of firms makes use of technical platforms and architectures to create and capture value for both the

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(networked) organization and the customer (Bouwman et al., 2008). We define BMI as a change in a company's BM that is new to the firm and results in observable changes in its practices towards customers and partners. The core focus of our research, however, is how companies and specifically SMEs experiment with BMs. We define BM experimentation as activities related to discussing and trying out changes in BMs carried out by a manager or a team with a budget specifically allocated for experimentation. Regarding BM practices, we focus on the way the team in charge of the experimenting process makes the transition from strategy to BMs in practice. It is about how strategy is actually implemented while experimenting with BMs.

Most research attention has been devoted to large enterprises, that are SMEs and the focus are very divers in nature, such as industry, size, phase of maturity, and in ownership, and that are considered to be the driving force in most economies. It is often emphasized that SMEs are responsible for employment, innovation, and growth in economies, as indicated by the OECD, European Union, and national governments. Therefore, SMEs and changes in their BMs are important to study. From a telecommunications, information technology, and an Information Systems (IS) perspective, innovations such as IT artefacts, social media, and big data are important topics of study. IT artefacts are combinations of hardware and software or even platforms that enable users to execute certain activities. Social media can offer an extra channel to communicate with customers, but it can also be developed more fundamentally as a service in itself. In the same way, big data can affect the business models of SMEs, not only in relation to marketing, but also to business processes. For instance, in the Industry 4.0 domain, monitoring production and production quality affects the BMs of many SMEs. BMI is not about optimizing internal processes or incorporating and implementing new technologies in an organization; innovation has to affect the core business logic of the SMEs and be observable to others.

Advanced technologies and concepts such as social media and big data are considered to play a core role in BMI in most firms. Therefore, in this paper we will focus on the questions: how digital technologies, specifically social media and big data, affect innovativeness and performance and how BMI mediates the impact of digital technologies on innovativeness and performance.

In the context of the H2020 Envision Project, we collected quantitative data and carried out case studies of BMI as executed by SMEs. Based on a *mixed method* approach we analyse a dataset of 338 European SMEs engaged in BMI related to IT artefacts, social media, and big data, and performed a number of in-depth case studies. The quantitative dataset is a subset of a larger sample of companies engaged in BMI ($N = 586$). Data were collected in 2016 as part of a panel research. The conceptual model we test relates to BM incentives and BM experimentation with (subjective) performance indicators (see Figure 1). We provide sample cases in which IT artefacts, social media, and big data (analytics) affect BMs. These cases help (re)focus our panel research, while quantitative research data help us to generalize findings from the cases.

In the next section, we draw on the mainstream business model factors from extant literature to build our research model. In Section 3, based on the discussion laid out in Section 2, we develop the research hypotheses. Section 4 discusses the research methodology, data collection process, and the development of measurements followed by research results in Section 5. Section 6 discusses the discussion. Section 7 outlines the research theoretical contribution, conclusions, limitations, and considerations for future work.

2. Theoretical Background

In this paper, we briefly discuss some insights from BMI literature. Traditionally, research on business models can be categorized in three primary areas: (a) the use of Internet, mobile, and information technologies on an infrastructure and application level (Bouwman et al., 2008); (b) strategic issues concerned with firm performance and value creation (Casadesus-Masanell & Ricart, 2010; Hedman & Kalling, 2003; Teece, 2010; Zott & Amit, 2008, 2010); and (c) innovation and technology management (Chesbrough, 2006, 2010; Zott et al., 2011). With the aim of not replicating existing BM literature overviews (Lambert & Davidson, 2013; Zott et al., 2011), our focus is limited to empirical studies on BMI. Studies in these fields are mostly based on cases, specifically in the domain of Internet, mobile, and information technologies. The extant quantitative studies are from the strategic and innovation management domain. From these studies, conceptual papers on entrepreneurship (Doganova & Eyquem-Renault, 2009), strategic management (Zott et al., 2011), or IS literature (Schneider & Speith, 2013), as well as empirical papers on BMI and performance (i.e., Aspara et al., 2010; Aziz & Mahmood, 2011; Clausen & Rasmussen, 2013; Huang et al., 2012) have often unclearly defined BMs and BMI (Foss & Saebi, 2017). Although we agree with Wirtz et al. (2016) that BMI requires a crucial transformation of the existing value proposition and/or value constellation, the problem is that core characteristics, components, or concepts of the value constellation are often ambiguously defined, depending on the specific ontology used (e.g., Hartmann et al., 2016; Souto, 2015). Some authors, for instance, offer a rather arbitrary list of components (Hartmann et al., 2016). These components are unrelated to components such as value proposition, customer segment, and key partners as used in CANVAS (Osterwalder et al., 2005). There are other components, such as service, technology platform/architecture, ecosystem, finance and risk-related uncertainties as used in the STOF (service, technology, organization and finance) model (Bouwman et al., 2008); and components (e.g., interface or service platform) used by VISOR (value proposition, interface, service platform, organizing model and revenue model) (El Sawy & Perreira, 2013) or by Christensen et al. (2016). The disagreement about what a BM is reflects also on the definitions of what BMI entails, so definitions in empirical papers are unclear or not provided. Some authors use revenue models as synonymous with BMs (Aspara et al., 2010; Aziz & Mahmood, 2011; Brettel et al., 2012).

Our approach is in line with Osterwalder et al. (2005) and Wirtz et al. (2016) that define BMI as the result of the rearrangement of a BM's components. Some authors such as Bucherer et al. (2012), Bonakdar (2015), Hartmann et al. (2016), and Frankenberger et al. (2013) follow also this view and define BMI as the deliberate modification of one or more firm's core components, or the introduction of new components. Björkdahl and Magnus (2013) stress that BMI can be the result of new combinations of new and old products or services, as well as changes in the firm's market position and process management. Lindgardt et al. (2009) focus on value delivery and define BMI as the reinvention of two or more BM components that can lead to novel ways of value delivery. The definition of Amit and Zott (2011) suggests that BMI can be the adoption of novel activities that defines the BM of a firm, the adoption of new linkages between existing activities, or the replacement of business actors in the firm's value network.

Moreover, most studies are vague on how core concepts are measured (Aziz & Mahmood, 2011). Velu (2015) considers diversification/product launch and external funding as two indicators of BMI. Others use dummy variables for consulting BM, technology BM, software BM, etcetera (e.g., Clausen & Rasmussen, 2013). Kim and Min (2015) define BMI simply as adding online retail activities or not. Souto

(2015) uses unspecified two-item scales. Huang et al. (2012) use a random list of components as indicators. Clauss's (2016) valuable paper focuses on developing a scale for BMI.

Moreover, the data used in empirical studies show some limitations. Some studies make use of the European Common Innovation Survey data as a proxy (Barjak et al., 2014; European Union, 2017) or data from existing databases (Cucculelli & Bettinelli, 2015; Hartmann et al., 2016; Kim & Min, 2015). Original data are seldom collected. Therefore, there is great diversity conceptually, both on the definition and operational levels, as well as in the use of data that is collected for other reasons.

In general, the empirical studies are diverse in their research focus, based on strategic management perspectives and linear econometric data analysis (e.g., Cucculelli & Bettinelli, 2015; Hartmann et al., 2013; Guo et al., 2013; Kim & Min, 2015; Zott & Amit, 2007). Performance is the key dependent variable, and most of the time linear regression analyses are used; some studies apply structural equation modelling.

It can be concluded that research is still rather scattered and sometimes lacks depth in understanding what BMI implies, what its antecedents are, and how it affects performance and innovativeness of firms. Moreover, to our knowledge, only research by Barjak et al. (2014) specifically addresses SMEs. Therefore, we developed and tested our own generic BMI model taking into account antecedents of BMI as well as outcomes.

IT artefacts play a role in many BMIs; however, here we are less interested in mobile or telecommunication BMIs or technologies that affect the channel mix in e-business or e-commerce solutions, and our focus is on technologies for creating IT artefacts that enable new usage possibilities. Literature on BM and BMI in relation to the role of social media and big data is more limited. In this literature review, we do not discuss social media in detail nor big data or big data analytics for that matter. We assume that readers are familiar with these concepts. We focus on the relation between these technologies and BMs. Moreover, publications on the relation between social media and business models are industry-specific and relate to smart tourism, media industry, or health care. Social media are often associated with new digital channels. The wide use of digital media, and especially of social media, led to the generation of big data that, according to several studies (e.g., Fosso-Wamba et al., 2015; Jin et al., 2015), can be analysed and used to create relevant information for businesses. However, big data has a broader application domain, not limited to digital marketing and personalization per se, but for instance, in Industry 4.0 applications.

3. Hypothesis development

The overall leading theoretical model as used in the Envision Project (Figure 1) posits that both internal (innovation activity and strategy) and external (competitiveness intensity and technology turbulence) factors directly influence the business model experimentation. We propose that business model experimentation positively influences business model practices. In addition, we propose that business model practice positively influences both innovativeness and overall business performance of a firm. Finally, we propose that innovativeness influences overall business performance. We introduce these concepts in the following subsections.

Innovation activity in an organization is defined as all the activities undertaken by a company to add value to its products and services. Therefore, the use of technologies such as some IT artefacts, social

media, and big data—which are perceived as innovative in themselves by most SMEs—can affect BM experimentation. We expect that an internal driver like innovative activity, when explicitly pursued by the firm, will lead to experimentation and therefore budget allocation and team activities in relation to BM will be supported. Companies that score high on innovation in general are also expected to be prepared to experiment with their BM. This will also be the case when technologies like IT artefacts, social media, and big data are considered.

H1: Innovation activity has a direct effect on business model experimentation.

Strategy is a concept that is often associated with business models or business planning. BMs involve the implementation of a strategy in the business logic on a more operational level. Therefore, an orientation towards strategic decisions in a firm will enable their implementation in the BM, and therefore, BM experimentation will be relevant. Openness to discussions on strategy will translate to experimentation with the BM by the SME.

H2: Strategy has a direct effect on business model experimentation.

Competitiveness intensity of a company defines its position in the business ecosystem and shows how it manages to compete with its rival companies. The more competitive the external environment is, the more discussions on what to do on a strategic as well as a BM level will be initiated.

H3: Competitiveness intensity has a direct effect on business model experimentation.

Technology turbulence has a direct effect on business. The evaluation and advancement of technological innovations over the last decades have been the fastest growing trend in the business in recent history. SMEs have to adjust to new technologies continuously and therefore will try to find out how new technologies affect their BMs. Moreover, they will experiment with new technologies and what they could mean for their BMs. This is also true, *ceteris paribus*, for new IT applications like the IT artefact under study, social media, and big data.

H4: Technology turbulence has a direct effect on business model experimentation.

Business model experimentation entails all the activities that a company conducts and supports in terms of changes to its business logic. Although there has been discussion in the literature in relation to a focus either on incremental change in parts of the BM or radical overhaul, we focus on enabling experimentation by allocating budget to teams engaged in experimentation, and the management of those teams, without focusing on the kind of experimentation carried out.

H5: Business model experimentation has a direct effect on business model practices.

The concept of business model practices involves the way the strategy of the company is expressed in its BM and the way that strategy is implemented. Innovativeness is seen as a dependent variable that represents the overall innovative output of the firm. Therefore, the more a SME translates strategy to its BM, the more innovations it will spin out.

H6: Business model practices have a direct effect on innovativeness.

H7: Business model practices have a direct effect on the overall performance of a company.

It is clear that innovation output will also affect the overall performance of the firm.

H8: Innovativeness has a direct effect on the overall performance of a company.

With the above-defined concepts and how they affect the overall performance of a firm, we propose the following research model to be tested via empirical research (Figure 1).

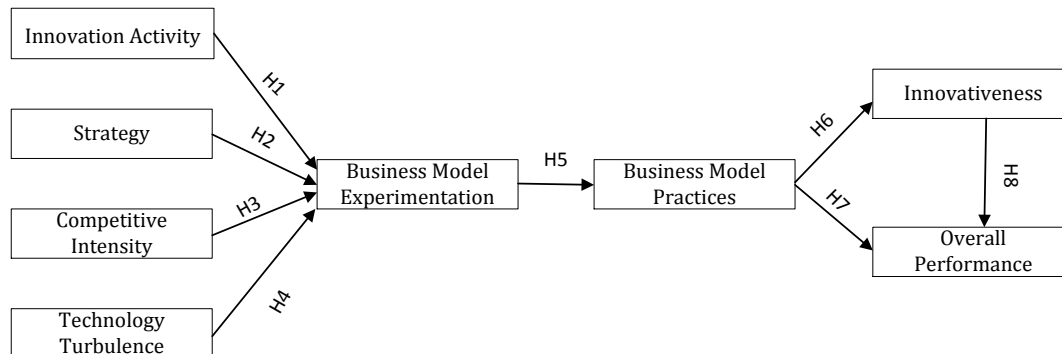


Figure 1. Research conceptual model.

4. Research Methodology: Quantitative Data

In this section, we elaborate on the method used in this study to examine and evaluate the proposed research model. Based on the above discussion, we performed empirical research to examine how digitalization enables firms to change or innovate their current business models.

4.1. Developing a Measurement Model

To ensure the reliability of the measurement and to have a comprehensive list of measures, we performed an extensive review on the existing literature in several disciplines such as entrepreneurship, strategic management, and business models. We selected all survey items for each latent construct from previously validated measures. We made minor modifications to fit the specific context of the research (i.e., impact of digital technology on firms' business models) when needed. For instance, data were collected on internal and external drivers, type of innovations, how BM change is managed, BM changes made, familiarity with and use of BM ontologies and tools, and performance and background characteristics. The overall performance of the firm was measured subjectively according to Venkatraman and Ramanujan's (1986) proposed model. Due to ethical constraints, we could not merge the data on the firms with data from statistical offices to use objective reported performance data. McDermott and Prajogo (2012) suggest that usage of subjective measures of performance is a valid proxy for objective performance measures.

We used sales volume and revenue growth as control variables. Next, Likert-type scales were used (1 = *totally disagree* to 7 = *totally agree*), based on well-known studies on innovation, entrepreneurship, and strategic management with regard to BMs of the firms (Zott & Amit, 2008; Subramanian, 1996 (see Table 1).

To find and identify the relationship among the constructs, the dataset was analysed using structural equation modelling (SEM) techniques. SEM is considered a general statistical modelling technique and has been used in various domains and disciplines extensively (see López-Nicolás, Molina-Castillo, & Bouwman, 2008; Nikou & Bouwman, 2014; Nikou & Bouwman, 2013; de Reuver et al., 2015). SEM is especially applicable when dealing with relationships among constructs such as in business model experimentation and overall business performance. The purpose of covariance-based SEM is to

“reproduce the theoretical covariance matrix, unlike the PLS-SEM which focuses on improving the explained variance” (Hair, Ringle, & Sarstedt, 2011, p. 139). In this study, we use partial least squares (PLS-SEM) method, which is a component-based estimation. Table 1 provides a list of the items used.

Table 1: Question items used in the study.

Construct & source	Items
<i>The following internal factors motivate a change on your business model during the last 12 months</i>	
Innovation activity (Zott & Amit, 2008)	New product development, innovation and R&D activity
	Innovation and/or R&D activities
	Advertising products and services in a new way
<i>The following internal factors motivate a change on your business model during the last 12 months</i>	
Strategy (Zott & Amit, 2008)	Scale up your business
	Focus your product offering
<i>The following internal factors motivate a change on your business model during the last 12 months</i>	
Competitive intensity (Jaworski & Kohli, 1993)	Price competition
	Competitors starting to offer similar products/services
	Competitor's reactions to your initiatives
<i>The following internal factors motivate a change on your business model during the last 12 months</i>	
Technology turbulence (Jaworski & Kohli, 1993)	Rapid changing technology
	Rapid increasing technological development
<i>How did you deal with business model innovation during the last 12 months</i>	
Business model experimentation (Sosna et al., 2010; Teece, 2010)	Experimented with the (implementation of) their business model
	Had a specific team to manage business model changes
	Allocated budgets for business model experimentation
<i>In your enterprise, business models are...</i>	
Business model practices (Ireland et al., 2009; Osterwalder, 2005)	Used to gain competitive advantages
	Designed in response to market circumstances
	Derived from enterprise's strategy
<i>In our enterprise,</i>	
Innovativeness (Subramanian, 1996)	We aim to create multiple innovations annually
	We introduce innovations that are completely new to the market
	Creating more than one innovation at the same time is common practice
<i>In our enterprise, we are very satisfied with</i>	
Overall performance (Venkatraman & Ramanujam, 1986)	The sales growth
	The profit growth

4.2. Survey Administration, Sample, and Data Collection

The questionnaire contains several concepts related to BM and BMI, as laid out in the theoretical section of this article. The questionnaire starts with a generic selection question, asking if the company under study has changed its BM in the last 24 months. Next, four specific selection questions were posed giving examples of BMI related to (a) value proposition and market; (b) ecosystem; (c) information technology, that is, use of social media and/or big data; and (d) pricing and related financial issues. The third question was used as a selection question to obtain a subsample of 338 SMEs involved social media and big data. These questions were included to make sure firms were actually involved in BMI (Langerak et al., 2004; Lee & O'Connor, 2003). Next, the key respondent in each firm had to prove that he/she was knowledgeable about BMI practices in their company (Atuahene-Gima, 2005).

The questionnaire was iterated and pretested, reading it aloud to managers and academics to improve clarity of the questions. We developed the questionnaire in English and then translated into 11 languages (i.e., Dutch, French, Finnish, German, Italian, Lithuanian, Polish, Portuguese, Slovenian, Spanish, and Swedish). We used the German questionnaire for Austria. In order to detect potential problems (e.g., ambiguous expressions) and cultural issues, we back-translated the questionnaire into English to ensure that translation did not introduce any bias in the measures. Moreover, we had a final check on translations and consistency between them made by a research agency. We pretested the questionnaire in every one of the 11 countries.

We collected the data through a professional research agency based in the Netherlands. This agency has extensive experience in data collection in multiple countries. They use native speakers and computer-assisted telephone inquiry. The countries we included in our research are spread over Europe and contain, for all European regions (North, West, Central, South, and East), a large country with large number of SMEs and a small country. Quota for micro, small, and medium enterprises was established as 33%, –33%, and –33%, respectively. There is no quota defined for industry sectors. We excluded agriculture, public administration, and nonmarket activities in households. The sample was based on Dun and Bradstreet database. Dun and Bradstreet collects data on companies, their executives, industry classification, and contact information on a regular basis from chambers of commerce and other organizations. Companies were randomly selected from the database and key respondents (owner or BMI manager) were interviewed. Identification data were not known to the researchers. The research agency also took into account the incidence rate that provides the hit rate, that is, the number of times a company is asked if they are involved in BMI before founding one that fulfils this requirement. Results obtained showed similarity patterns between countries. As a further test, we assessed the respondents' suitability (Atuahene-Gima, 2005) to answer the questionnaire and their degree of knowledge (1 = very limited knowledge, 7 = very substantial knowledge) regarding the product/service on offer, business process, and new product/service development. Mean responses were 6.7, 6.6, and 5.9, respectively, which indicates adequate knowledge levels.

5. Data Analysis and Results

5.1. Validity and Reliability

The composite reliability (CR) test examines the internal consistency and reliability of the latent constructs. CR threshold is 0.70 or higher. More specifically, value between 0.60 and 0.70 is recommended in exploratory research, and between 0.70 and 0.90 in other stages of research; value under 0.60 is seen as lacking reliability (Hair et al., 2011; Nunnally & Bernstein, 1994). Table 2 shows that each construct satisfied the recommended value and indicates that all constructs have reliability.

Cronbach's alpha is a common test for internal reliability of latent constructs (Bryman & Bell, 2011) and it is recommended to be higher than .70 (Hair et al., 2011; Urbach & Ahlemann, 2010). Statistics from Table 2 show that reliability of all constructs, except for one (strategy), is satisfied.

Convergent validity is presented by average variance extracted (AVE) and should be higher than 0.50 (Hair et al., 2011). All of the latent constructs in Table 2 have sufficient convergent validity: $AVE > 0.649$. Factor loading accounts for unidimensionality of measuring items (Awang, 2012). The value of factor loading for an established item should be 0.6 or higher. It is necessary to remove items from the measurement model if their factor loadings are low, one item at a time. The remaining eligible items,

listed in Table 2, show acceptable convergent validity, internal consistency and reliability of the measuring items, and are all consistent with the recommended threshold values.

Table 2. Descriptive statistics, convergent validity, and internal consistency and reliability of items.

Construct	Items	Factor Loadings	Mean	Std. dev	t-statistic	α	CR ^b	AVE ^a
Innovation activity	Q11_1	0.81	4.10	2.11	35.00	0.728	0.847	0.649
	Q11_2	0.87	3.74	2.06	64.04			
	Q11_3	0.74	4.09	2.05	25.93			
Strategy	Q11_6	0.87	4.25	2.02	47.22	0.615	0.828	0.721
	Q11_7	0.83	4.40	1.96	33.63			
Competitive intensity	Q12_2	0.79	4.26	2.01	20.87	0.783	0.869	0.690
	Q12_3	0.80	3.92	2.01	20.98			
	Q12_4	0.90	3.47	1.89	39.91			
Technology turbulence	Q12_7	0.89	3.86	2.03	127.78	0.892	0.949	0.903
	Q12_8	0.88	3.84	2.02	143.87			
Business model experimentation	Q3_1	0.86	3.60	2.11	65.02	0.785	0.874	0.700
	Q3_2	0.80	3.10	2.24	37.70			
	Q3_3	0.84	3.06	2.19	58.98			
Business model practices	Q4_1	0.85	4.98	1.98	54.02	0.811	0.888	0.725
	Q4_2	0.84	5.06	1.85	44.00			
	Q4_4	0.86	4.74	1.97	54.40			
Innovativeness	Q13_7	0.88	4.11	1.96	58.60	0.802	0.883	0.716
	Q13_8	0.83	3.55	1.99	47.28			
	Q13_9	0.84	4.02	2.03	46.40			
Overall performance	Q14_1	0.93	4.30	1.62	94.96	0.816	0.915	0.844
	Q14_2	0.91	4.05	1.65	67.66			

5.2. Discriminant Validity

Assessing discriminant validity is a building block of model evaluation (Hair et al., 2010). Discriminant validity guarantees the uniqueness of a measuring construct and indicates that the phenomenon of interest is not captured in other measures (latent variables) within the research model (Hair et al., 2010; Henseler et al., 2015). This paper uses both the Fornell–Larcker and heterotrait-monotrait ratio (HTMT) criteria for discriminant validity assessment. Table 3 shows that the AVE value satisfies the constraints and shows that the constructs as well as the measuring model are adequately discriminated.

The second criterion for the discriminant validity assessment, HTMT, is used for assessing discriminant validity in PLS-SEM. However, literature on PLS-SEM shows that scholars predominantly use the Fornell–Larcker criterion and cross-loadings for discriminant validity assessment in variance-based structural equation modelling. The classical criterion (i.e., Fornell–Larcker criterion) for discriminant validity assessment requires the square root of AVE to be greater than the correlation of the construct with all other constructs in the structural model. For example, the square root of the AVE is 0.74, however, if the correlation between constructs C1 and C2 is 0.80, we can conclude that discriminant validity has not been established.

Table 3. Correlation among constructs and square root of the AVE.

	1	2	3	4	5	6	7	8
Business Model Practices	0.85							
Business Model Experimentation	0.52	0.84						
Competitive Intensity	0.24	0.21	0.83					
Innovation Activity	0.41	0.47	0.40	0.81				
Innovativeness	0.44	0.45	0.30	0.60	0.85			
Overall Performance	0.32	0.29	0.13	0.28	0.33	0.92		
Strategy	0.36	0.44	0.42	0.61	0.44	0.25	0.85	
Technology Turbulence	0.33	0.40	0.43	0.55	0.41	0.20	0.45	0.95

Bold values show square roots of the AVE (see Table 3).

HTMT is an alternative to the classical criterion for assessing discriminant validity; it is the average heterotrait-heteromethod correlations measuring the relative to the average monotrait-heteromethod correlations. Monotrait-heteromethod is the correlation of indicators measuring the same construct and heterotrait-heteromethod is the correlation of indicators across constructs measuring different phenomena. HTMT value close to 1 indicates lack of discriminant validity, however, some authors such as Henseler et al. (2015, p. 129) suggest a conservative value of 0.85 for HTMT and a more liberal value of 0.90. According to this recommendation, if HTMT values are less than 0.85, we can establish that discriminant validity is not an issue. Table 4 shows that HTMT values satisfy even the more liberal criterion, as all the values are below 0.85.

Table 4. Heterotrait-monotrait ratio (HTMT).

	1	2	3	4	5	6	7
Business Model Practices							
Business Model Experimentation	0.648						
Competitive Intensity	0.294	0.254					
Innovation Activity	0.538	0.618	0.513				
Innovativeness	0.541	0.556	0.348	0.778			
Overall Performance	0.386	0.357	0.151	0.358	0.41		
Strategy	0.507	0.631	0.589	0.89	0.62	0.342	
Technology Turbulence	0.39	0.472	0.504	0.684	0.478	0.23	0.612

5.3. Structural Model Analysis

To test the hypotheses and figure out the statistical significance of the path coefficients in the research model, we used structural equation modelling (SEM). The fit of the model is satisfactory, chi-square (χ^2) = 669.87 and degree of freedom (df) = 216. The overall performance is explained by a variance of 15%, innovativeness is explained by a variance of 20%, and business model experimentation and business model practices are explained by variances of 28% and 27% respectively. Figure 2 indicates the relationships between constructs in the model, bold lines represent significant relationships and dotted lines show insignificant relationships or unsupported hypotheses. We used six different fit statistics—root mean square error of approximation (RMSEA), goodness-of-fit index (GFI), adjusted

GFI (AGFI), normed fit index (NFI), Tucker–Lewis index (TLI), and comparative fit index (CFI). These model fit indices satisfy the recommended guidelines and show that our research model has a good fit with the data (Browne & Cudeck, 1993; see Table 5).

Table 5. Model fit indices.

Model fit Indices	GFI	AGFI	CFI	NFI	TLI	RMSEA
Cut-off value	>0.90	>0.80	>0.90	>0.80	>0.90	<0.080
Obtained value	>0.91	>0.88	>0.92	>0.89	>0.91	<0.048

5.4. Hypotheses Testing

We have tested different alternative models, and the model presented in Figure 2 is the optimal model and fits best the data. Table 6 shows the research hypotheses and analysis results. The results reveal significant relationships between innovation activity ($\beta = 0.26, p < .001$) and strategy ($\beta = 0.23, p < .001$) with business experimentation and thus H1 and H2 are respectively supported in the model. The results show that there is no significant relationship between competitiveness intensity (H3) and business model experimentation and thus H3 is not supported in the model. The analysis shows that technology turbulence drives BM experimentation and reveals a significant path ($\beta = 0.17, p < .001$), thus H4 is supported in the model.

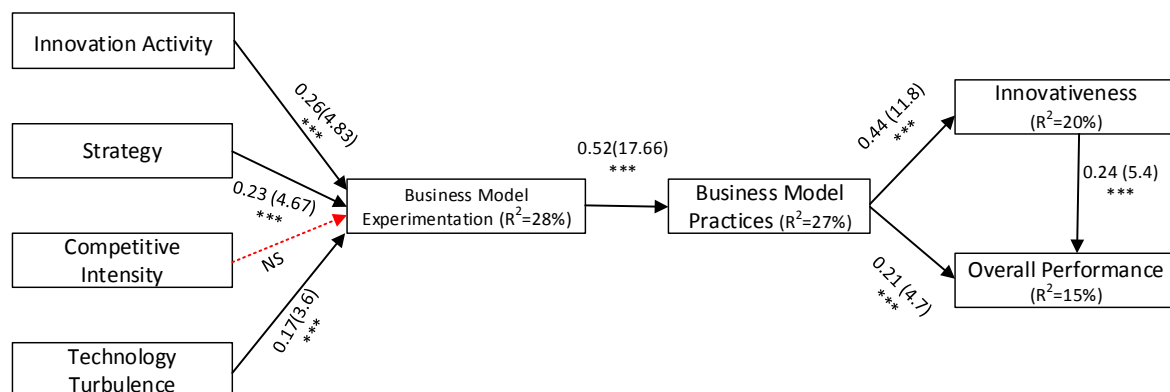


Figure 2. Results of the research model.

Notes: *** p-value < 0.001; ** p-value < 0.005; * p-value < 0.01.

Moreover, the results show a significant path between BM experimentation and BM practices ($\beta = 0.52, p < .001$) and thus H5 is supported in the model. We observe a strong significant relationship between BM practices and innovativeness ($\beta = 0.44, p < .001$) and thus H6 is supported in the model. Business model practices also have a significant relationship with overall business performance ($\beta = 0.21, p < .001$) and thus H7 is supported in the model. Finally, the analysis shows that innovativeness has a significant relationship to overall business performance ($\beta = 0.24, p < .001$) and thus H8 is supported in the model.

Table 6. Hypotheses and results.

#	Hypotheses	Results
H1	Innovation activity has a direct positive effect on BM experimentation	Supported
H2	Strategy has a direct positive effect on BM experimentation	Supported
H3	Competitive intensity has a direct positive effect on BM experimentation	Not supported
H4	Technology turbulence has a direct positive effect on BM experimentation	Supported
H5	BM experimentation has a direct positive effect on BM practices	Supported
H6	BM practices has direct positive effect on innovativeness	Supported
H7	BM practices has direct positive effect on overall performance of a company	Supported
H8	Innovativeness has a direct positive effect on overall performance of a company	Supported

5.5. Case Studies

This research is based on a case study approach (Eisenhardt, 1989; Yin, 2013). Since research into BMI in the context of SMEs is a new phenomenon, our approach is relatively inductive. As part of a large European project, we built a database of 85 BMI cases in SMEs. To collect the data, we used a common case study protocol, which is available on request and which includes the SMEs relevant to the sample, the information that was collected, and how the data from different sources (triangulation) were used. Data sources include interviews, relevant documents, and business model descriptions and/or pictures. We structured the data according to an existing template that contains information on topics such as:

- Background characteristics of the firm (information sheet).
- Validation of interviews by interviewees and case reviews by other researchers involved in the project.
- Assessment of the firm's strategy focus and innovativeness
- Backed up with factual R&D information (if available) and market focus.
- Information on the value proposition and business model (innovation).
- Information on the impact of the BMI on the business logic and business performance of the firm.

Data collection is ongoing and thus, the depth and detail of the case descriptions vary. In light of the diversity of SMEs in terms of size (from very small to medium-sized), industry (from personal services and retail to high-tech industries), maturity (from start-ups to well-established family business with more than 300 years of experience), and country within Europe, a wide range of information is available.

We selected four cases with a clear focus on business model, a specific IT artefact, social media, or big data. We used theoretical sampling to select our cases based on two dimensions, the first of which is the technology at stake—for example, IT artefact, social media or big data—and the other is whether the companies are users or producers of IT applications (see Table 7 for information on the cases).

Table 7. Design of case studies.

	ICT users	ICT producers
Social Media	Hamburger restaurant	Audio Guide Service Provider
Big Data	Digital Marketing Solution Provider	Provider of analytics for Brick stores

5.6. Case Study Results

1. This case is about a Spanish family business with multiple hamburger restaurants in Madrid. The second generation is pushing BMI by making use of Social Media. The first restaurant was opened in 1981 and is a typical American-style hamburger joint venture. Ratings of the food are very positive and any negative reviews focus on poor service. The owners rely strongly on a loyal customer base. The restaurant has a social media manager who uploads 3–4 posts per day. Social media use is not really focussed on interaction with customers, but only on promotions. Based on analyses of reviews on Facebook, Twitter, and other channels like Instagram and Foursquare, the problem is mainly service-delivery-related. For instance, there are long queues for the restaurant due to its poor reservation system, which relies on telephone and website, and people have to wait up to 1 hour even if they make a telephone or website reservation, especially during weekends. The BMI concerns the integration of social media in the reservation process. The objective is to develop a reservation system that is able to handle reservations in real time via multiple channels including Facebook and Twitter, and to connect the reservation system to the in-restaurant point-of-sales and table management system. For instance, Twitter can be used to give updates on availability of tables, to invite people to make reservations, and to respond to possible service-related problems. Making use of data collected by these systems, the reservation system can be optimized leading to a reduced mismatch between reservations and availability of tables. From a BMI perspective, we can conclude that promoting a value proposition without branding via Facebook and Twitter is in itself not good enough to achieve impact. This Spanish hamburger restaurant is exploring opportunities to combine their social media presence with their in-house restaurant systems. This example illustrates how social media can be used. The core case organization is open to innovative activities but not actively reconsidering their BM. Their core business remains the same, and social media only optimize one of their activities.

2. The focus of this Polish audio-guide service provider is on business model design and innovation to offer a platform, that is, an IT artefact to take digital audio tours of museums, cities, etcetera. This is realized making use of local knowledge and content providers, and is made available smartphones to consumers directly via smartphones. This company creates its own social media network, including regional ambassadors that verify trips. To collect local information, the company uses this network, amongst other more formal sources. Social media also function as a back channel to improve the information regarding the tour, if commented upon by end-users of the trip data. Due to lack of economic sustainability of the original BM, the company started to provide the technology as a B2B solution. The company is pursuing a strategy to use internal innovation for market expansion. The BMI process was managed internally by the CEO. External stakeholders were involved to validate the idea in the development phase to evaluate its odds of succeeding.

3. This UK digital marketing solution provider operates in the British digital marketing and consultancy market. Their main activities are providing consultancy to boost clients' online visibility and training to assist clients on digital marketing issues. The company is highly dependent on Google Analytics. Changes in algorithms have huge impact on the operations and business model of the company. Due to changes in algorithm, they had to adjust some components of their business model. Big data and big data analytics could offer opportunities. This change required new resources, for example, technological infrastructure and the knowledge base of the company. The (re)use of data and the use of data from third-party providers is paramount. Thus, new business units were needed and established, which created a new demand and, consequently, a change in value proposition. These changes have reflected, for instance, in offering training in the big data analytics (BDA) field. The BMI is led by core managers, that is, the CEO and the Director of Strategy. Radical changes were made in (a) resources and team management, (b) service offerings, (c) promotion activities, and (d) partner network. In the end, these radical changes only had a minor disruptive impact on performance.

4. The core technology of this Finnish business analytics provider for traditional brick-and-mortar stores was initially focussed on collecting in-store behavioural data and providing analytics to help small retailers personalize the customer experience. The technology used is in-store localization technology based on sensors and Wi-Fi. This makes it possible to follow customers as they roam around in a store. The technology can run on existing infrastructure already available within stores. The company started offering customized solutions to small retail stores, which led to impressive growth rates. However, the application developed to improve in-store design, using augmented advertising offered through a large technology provider, which increased sales. The company is currently being expanded to use their technology and analytics in optimization of passenger flows in airports. Thus, the technology is being reused in a different setting leading to a new customer segment and a new value proposition no longer supporting sales, but optimizing passenger flows. The expansion led to partnering with a large traditional service provider as well as a technology provider. The case illustrates that changes in business models benefit the provider and change its position in different ecosystems. Also, the company of this big data and BDA case became a niche resource provider to others, which shows that the emergence of data-driven business models enables improvement of sales (channels) and optimizing of key activities.

5.7. Cross-Case Comparison

We mapped the four cases onto the conceptual model and the cases confirmed earlier findings. It is clear from this mapping that the potential of new technologies and the focus on innovation play an important role in a firm business performance. Strategic considerations are mainly relevant to the big data cases, more or less suggesting that the impact of big data is from its strategic value, while social media only play a minor role as used to collect or disseminate information. It also striking that the impact of big data and BDA on innovativeness of companies and on their performance is also clearer for the big data cases than for the social media ones. BM experimentation clearly takes place in three out of the four cases, however, strategy implementation in the BM per se is not explicitly being mentioned or discussed.

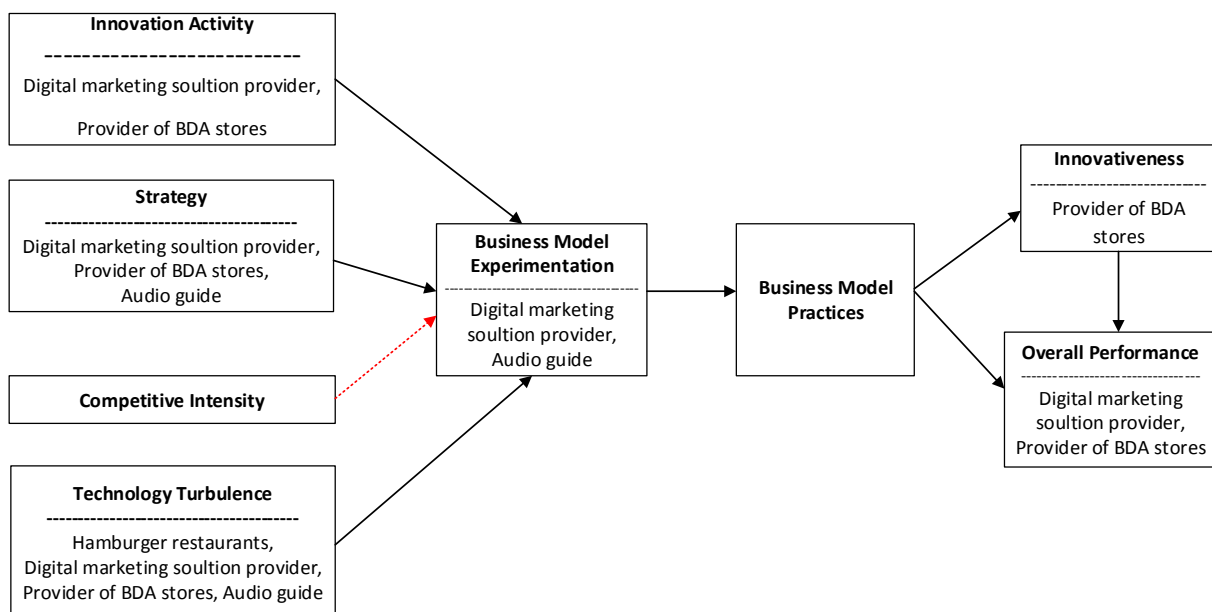


Figure 3. Case studies mapped on the conceptual model.

6. Discussion

The findings from both the quantitative study as well as the case studies illustrate that internal drivers related to innovative activities and strategy, as well as technology turbulence, play an important role when social media and big data are part of BMI. The case studies show some nuance by suggesting that the impact of big data is more extensive than that of social media. This can be explained by observing that social media usage relates more to channels, while big data can affect companies in all their core activities and the activities of their key partners.

We also see how important it is to make resources and management structure available for BMI. As illustrated by both the quantitative data and case studies, this is a condition for the practice of implementing companies' strategy in their BMs. It was found that BMI and practices of implementing strategy in BM led to more innovations and increased performance, even when major changes were made.

The current study only gives an overall picture of the relations between BMI drivers, behaviour, and outcomes. The case studies offer more detail, however, it is clear that more in-depth understanding of BMI is necessary. Specifically, the order in which BM components are being changed is an important issue to study. Understanding BMI paths as well as roadmaps to implement it is important for SMEs. BMI paths need to be developed not only for topics like market expansion, internationalization, and starting companies, but also for how BMI related to certain technologies works out. From the cases, it can be argued that the characteristics of the technology play a crucial role in the incremental or radical nature of the BMI. The IT artefact and the social media cases yield different impacts than the big data cases. With regard to big data and BDA, it is immediately clear—and discussed by the case companies—that BM experimentation has an impact on innovativeness and performance; this is not the case for the IT artefact and the social media cases. This would also imply that the conceptual model (Figure 1) needs to be tested not for both technologies together but for specific technologies.

As literature on BMI and new digital technologies such as the discussed artefact, social media, and big data for nontelecommunication or non-IT companies is rather scant—the literature on BM is mainly focussed on large companies and high-tech start-ups—the way technologies drive or impact the BMs of traditional SMEs is largely open for new avenues of research. In the context of understanding digitalization of businesses, research on the impact of new technologies for traditional as well as new emerging industry sectors like digital marketing, is highly relevant. Our research contributes to both. It is important to stress that big data might have a huge impact on BMI and on performance of firms. Exploring big-data-driven business models might be a very important research domain.

7. Conclusions, Limitations and Future Work

Our research contributes to insights internal and external to BMIs and to literature on the impact of BMI on performance and outcomes. It is important to understand how BMI is taking place in organizations and how strategies are implemented in the business logic. As research shows, both quantitative as well as qualitative research on BMI matter. With this paper, we contribute to a better understanding of how digitalization in BMI works out. However, we are also aware that we only dealt with a small part of a vast area of research. We would like to focus in more detail on how companies experiment, how BM components are affected, and how implementation approaches with regard to human and organizational factors affect the performance of BMI.

Of course, our research has some limitations, which are related to both the quantitative as well as the qualitative studies, and the fact that SMEs are rather diverse in their field of operations. Moreover, we conducted the research in Europe, with many different languages, cultural, and economic differences despite the common market. The case study research illustrates this diversity. The differences between the cases can be attributed to many other factors than differences in technology or in providing or using IT. Case studies with a focus on SMEs are hindered by the lack of alternative sources of data which makes them highly dependent on information provided by the owner, manager, or a core spokesperson, with little opportunity to access other, alternative, interviewees.

There are also some limitations with regard to our research design. We specifically focus on companies that are knowingly or subconsciously engaged in BMI. Research comparing companies involved in BMI and companies not engaged in BMI might provide deeper insights. In addition, our measurements are based on subjective judgments; connecting these subjective judgments with real performance data would be what we would have strived for, but this is not possible due to European rules in relation to research ethics and informed consent. In future research, we will focus on collecting another wave of data in order to establish causalities more clearly, as well as expanding our insights into how BMI actually takes place. This research will entail both quantitative analyses as well as extending the case studies.

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