The impact of digitalization on business models

Harry Bouwman, Shahrokh Nikou, Francisco J. Molina-Castillo and Mark de Reuver

Abstract

Purpose – *This paper aims to explore how digital technologies have forced small- to medium-sized enterprises (SMEs) to reconsider and experiment with their business models (BMs) and how this contributes to their innovativeness and performance.*

Design/methodology/approach – *An empirical study has been conducted on 338 European SMEs actively using social media and big data to innovate their BMs. Four in-depth case studies of companies involved in BM innovation have also been carried out.*

Findings – *Findings show that the use of social media and big data in BMI is mainly driven by strategic and innovation-related internal motives. External technology turbulence plays a role too. BMI driven by social media and big data has a positive impact on business performance. Analysis of the case studies shows that BM is driven by big data rather than by social media.*

Research limitations/implications – *Research into big data- and social media-driven BMs needs more insight into how components are affected and how SMEs are experimenting with adjusting their BMs, specifically in terms of human and organizational factors.*

Practical implications – *Findings of this study can be used by managers and top-level executives to better understand how firms experiment with BMI, what affects business model components and how implementation might affect BMI performance.*

Originality/value – *This paper is one of the first research contributions to analyse the impact of digitalization, specifically the impact of social media and big data on a large number of European SMEs.*

Keywords *Business model, Business model innovation, Social media, Big data, Digitalization*

Paper type *Research paper*

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1. Introduction

Attention to business model innovation (BMI) is increasing in both entrepreneurial practice and research (Zott and Amit, 2010). In this paper, the concept of BM is defined as the business logic to create and capture value for both consumers and businesses. In other words, it refers to the way a single organization or a network of firms collaborates at 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 (networked) organization and the customer (Bouwman *et al.*, 2008). BMI is defined as a change in a company's BM that is new to the firm and results in observable changes in its practices toward customers and partners. The focus of our research, however, is how companies and specifically small- to medium-sized enterprises (SME) experiment with BMs as a result of digital transformation, specifically with regard to social media and big data. BM experimentation is defined 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 BM experimentation. In this paper, we focus on BM practices, defined as the way the team in charge of the experimenting process makes

the transition from strategy to BMs in practice through digital transformation. It is about how strategy is actually implemented while experimenting with social media- and big data-driven BMs.

Much research attention has been devoted to SMEs, which are considered to be the driving force in most economies. Research has had very diverse foci, such as industry, size, phase of maturity and ownership. It is often emphasized that SMEs are responsible for much of the employment, innovation and growth in national economies, as indicated by the Organization of Economic Cooperation and Development (OECD), European Union and national governments. Therefore, study of SMEs and changes in their BMs is important. From the perspective of telecommunications, information technology (IT) and information systems (IS), innovations such as social media and big data are important topics of study. Social media can offer an extra channel to communicate with customers, but it can also be developed as a service in itself. Similarly, big data can affect SMEs' BMs, with regard to not only marketing but also business processes. For instance, in the industry 4.0 domain, monitoring production and production quality affect many SMEs' BMs. 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 SMEs and be observable to others.

Advanced technologies such as social media and big data are considered to play a core role in BMI in most firms and therefore also in SMEs. However, what drives BM innovations based on digital technology and how experiments with BMI affect performance is, to our knowledge, not yet researched. Therefore, in this paper, the main questions are as follows:

Q1. How digital technologies, specifically social media and big data, have forced SMEs to reconsider their BM? How BMI mediates the impact of digital technologies on innovativeness and performance?

In the context of the H2020 Envision Project, quantitative data were collected and case studies of BMI as executed by SMEs were carried out. Based on a *mixed-method* approach, a data set of 338 European SMEs engaged in BMI related to social media and big data were analysed, and a number of in-depth case studies were performed. The quantitative data set is a subset of a larger sample of companies engaged in BMI ($N = 586$). Data were collected in 2016. The conceptual model under investigation relates to BM incentives and experimentation with (subjective) performance indicators. Several sample cases in which social media and big data (analytics) affect BMs were conducted to deepen the insights obtained from the quantitative data.

In the next section, mainstream BM factors from extant literature are drawn to build our research model. In Section 3, based on the discussion laid out in Section 2, the research hypotheses are developed. Section 4 discusses the research methodology, data collection process and the measurement development, followed by research results in Section 5. Section 6 presents the discussion of findings. Section 7 outlines the research's theoretical contributions, conclusions, limitations and considerations for future work.

2. Theoretical background

Here, we briefly discuss some main concepts from the BM innovation literature. Conventionally, research on BMs can be categorized into three main areas:

1. the use of internet, mobile and IT on an infrastructure and its application level (Bouwman *et al.*, 2008);
2. strategic issues concerned with firm performance and value creation (Casadesus-Masanell and Ricart, 2010; Hedman and Kalling, 2003; Methlie and Pedersen, 2007; Teece, 2010; Zott and Amit, 2008, 2010); and

3. innovation and technology management (Chesbrough, 2010, 2006; Waldner *et al.*, 2015; Zott *et al.*, 2011).

With the aim of not replicating the existing BM literature reviews (Lambert and Davidson, 2013; Zott *et al.*, 2011), our focus is limited to empirical studies on BMI. BMI is defined as the changes made in the business logic for creating and capturing value. BM changes need to be evident for stakeholders, including customers and/or end users and are often explicit due to change in BM components. BM components are the building blocks of a BM, such as value proposition, activities of actors supporting the ecosystem, pricing or revenue model and risk attribution. Studies of BMs are mostly based on cases, specifically in the domain of internet, mobile and IT (Ballon, 2007; Bouwman *et al.*, 2008). Extant quantitative studies are within the strategic and innovation management domain. From these studies, conceptual papers on entrepreneurship (Doganova and Eyquem-Renault, 2009), strategic management (Zott *et al.*, 2011) or IS literature (Schneider and Spieth, 2013), as well as empirical papers on BMI and performance (Aspara *et al.*, 2010; Aziz and Mahmood, 2011; Clausen and Rasmussen, 2013; Huang *et al.*, 2012) have often unclearly defined BMs and BMI (Foss and 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 (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 other concepts such as value proposition, customer segment and key partners as used in the BM CANVAS (Osterwalder *et al.*, 2005). Other components such as service, technology platform/architecture, ecosystem and finance and risk-related uncertainties are used in the STOF (service, technology, organization and finance) model (Bouwman *et al.*, 2008), while components such as interface or service platform have been proposed by the VISOR (value proposition, interface, service platform, organizing model and revenue) model (El Sawy and Pereira, 2013). The disagreement about what a BM is reflects also on the definitions of what BMI entails; thus, definitions in empirical papers are unclear or not provided. Some authors use revenue models as synonymous with BMs (Aspara *et al.*, 2010; Aziz and 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) also follow 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 (2010) suggests that BMI can be the adoption of novel activities that define the BM of a firm, the adoption of new linkages between the existing activities or the replacement of business actors in the firm's value network.

Most studies are vague about how core concepts are measured (Aziz and Mahmood, 2011). Velu (2016) considers diversification/product launch and external funding as two indicators of BMI. Others use dummy variables for consulting BM, technology BM, software BM, etc. (Clausen and Rasmussen, 2013). Kim and Min (2015) define BMI simply as adding online retail activities. Souto (2015) uses unspecified two-item scales. Huang *et al.* (2012) use a random list of components as indicators. Clauss's (2017) valuable paper focuses on developing a validated 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 the existing databases (Cucculelli and Bettinelli, 2015; Hartmann *et al.*, 2016; Kim and Min, 2015). Original data are seldom collected. Therefore, there is great diversity conceptually, both at the definition and operational levels, as well as in the use of data collected for other reasons.

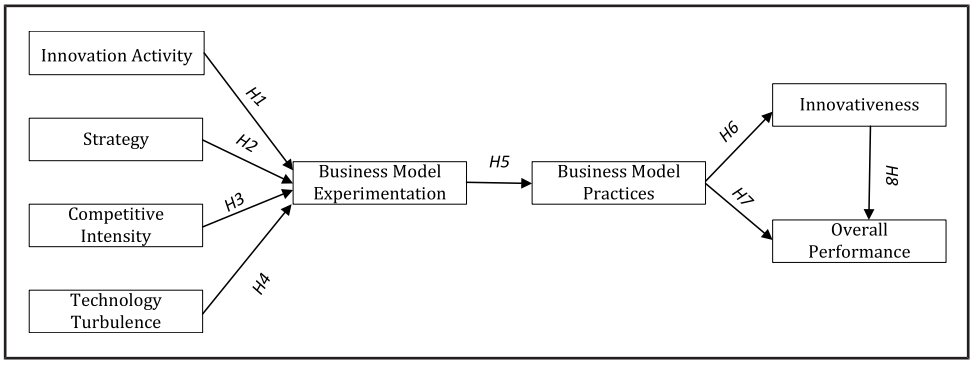
In general, empirical studies are drivers in their research focus, based on strategic management perspectives and linear econometric data analysis (Cucculelli and Bettinelli, 2015; Guo *et al.*, 2015, 2013; Hartmann *et al.*, 2016; Kim and Min, 2015; Zott and Amit, 2007). Performance is the key dependent variable and, most of the time, linear regression analyses are used; some studies apply structural equation modelling.

It can be concluded that research on digital transformation and BMI is still rather scattered and sometimes lacks an in-depth understanding of what BMI implies, what its antecedents are and how it affects firms' performance and innovativeness. Moreover, to our knowledge, research by Barjak *et al.* (2014) alone specifically addresses SMEs. Therefore, a generic BMI model taking into account the antecedents of BMI as well as outcomes is developed and tested. Literature on BM and BMI in relation to the role of social media (Hanna *et al.*, 2011) and big data (Hartmann *et al.*, 2016) is limited and often industry specific (Friedrichsen, 2013; Sigala *et al.*, 2012). The focus of this paper, therefore, is on the relation between these technologies and BMs. Publications on the relation between social media and BMs are industry-specific and relate to smart tourism, media 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 (Fosso-Wamba *et al.*, 2015; Jin *et al.*, 2015), can be analysed and used to create relevant information for businesses.

3. Hypothesis development

The overall leading theoretical model (Figure 1) posits that both internal (innovation activity and strategy) and external (competitiveness intensity and technology turbulence) factors directly influence BM experimentation. This paper proposes that BM experimentation – discussing and trying out changes in BMs – positively influences BM practices, that is, the transition from strategy to BM in practice. In addition, this paper proposes that BM practices positively influence both innovativeness and the overall business performance of a firm. Finally, this paper proposes that innovativeness

Figure 1 Research conceptual model



influences the overall business performance. These concepts are introduced 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 social media and big data – which are perceived as innovative in themselves by most SMEs – can affect BM experimentation. An internal driver like innovative activity, when explicitly pursued by the firm (Hurley and Hult, 1998; Utterback and Abernathy, 1975), is expected to lead to experimentation and therefore, budget allocation and team activities in relation to BM will be supported. Companies that score high on innovation – whether it is product, marketing or organizational innovation – are generally expected to be prepared to experiment with their BM. This will also be the case when technologies such as 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 BMs or business planning. BMs involve the implementation of a strategy in the business logic on a more operational level. Therefore, an orientation toward strategic decisions in a firm will enable their implementation in the BM, and therefore, BM experimentation will be relevant (Casadesus-Masanell and Ricart, 2010; Chesbrough, 2010; Chesbrough and Rosenbloom, 2002). Openness to discussion on strategy will translate into SME's experimentation with its BM.

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 (Carayannis and Provance, 2008; Casadesus-Masanell and Ricart, 2010; Pauwels and Weiss, 2008).

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

Technology turbulence has a direct effect on business (Johnson *et al.*, 2008). The evaluation and advancement of technological innovations over the past decades have been the fastest growing trend in business in recent history. SMEs have to adjust to IT applications continuously and therefore will try to find out how new technologies affect their BMs. Moreover, they will experiment with IT applications and what they could mean for their BMs. This is also true, *ceteris paribus*, for new IT applications like social media and big data.

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

BM experimentation entails all the activities that a company conducts and supports in terms of changes to its business logic. Although previous studies have discussed on either incremental change in parts of the BM or radical overhaul, this study focuses on enabling experimentation by allocating budget to teams engaged in experimentation and the management of those teams, rather than the kind of experimentation carried out.

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

The concept of BM 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 transfers strategy to its BM, the more innovations it will be able to spin out.

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

Business performance can be significantly affected by BM practices, as firms that are more focused on BMI outperform firms that do not, in terms of profit (Giesen *et al.*, 2010, 2007). Besides, the IBM CEO study reported that CEOs from top firms acknowledge the impact of BMI on the operating margin growth in their companies (Pohle and Chapman, 2006). BMI has become one of the three main foci of innovation for these CEOs to improve their firms' business performance. By innovating their BMs, firms can also gain competitive advantage, as BMs might be hard to replicate; thus, this allows firms to continue being profitable (Chesbrough, 2006). Market share of a small–medium firm or start-up can also be positively affected by BM practices as a novel BM can recombine the existing internal resources or use external partners' resources (Zott and Amit, 2007).

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 a firm. Innovation can have a positive effect on business performance as it can enable firms to develop competitive advantage (Hult *et al.*, 2004; Hurley and Hult, 1998). Firms willing to innovate will focus on activities that give them better capacity to do so (Hurley and Hult, 1998). This willingness to innovate is mainly driven by market, learning and entrepreneurial orientation (Hult *et al.*, 2004). This orientation drives firms to improve continuously to adapt to the constantly changing market, which, if their competitors cannot keep up, will give them a competitive advantage and improved business performance. Hence, we propose the next hypothesis:

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

Considering the above-defined concepts and their effects on the overall performance of a firm, the following research model is proposed to be tested via an empirical research (Figure 1).

4. Research methodology: quantitative data

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

4.1 Developing a measurement model

To ensure the reliability of the measurement and have a comprehensive list of measures, an extensive review of the existing literature on several disciplines such as entrepreneurship, strategic management and BMs was executed. All survey items for each latent construct were selected from previously validated measures. Data were collected on internal and external drivers, type of innovations, the changes in BM and their management, 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 the model proposed by Venkatraman and Ramanujan (1986). Due to ethical concerns, merging the firms' data with data from statistical offices to use objective reported performance information could not be done. McDermott and Prajogo (2012) suggest that the use of subjective measures of performance is a valid proxy for objective performance measures.

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

Table I Question items used in the study

Construct and source	*Items*
The following internal factors motivate a change on your business model during the past 12 months	
Innovation activity (CIS Survey, 2016)	New product development, innovation and R&D activity Innovation and/or R&D activities Advertising products and services in a new way
The following internal factors motivate a change on your business model during the past 12 months	
Strategy (Zott and Amit, 2008)	Scale up your business Focus your product offering
The following internal factors motivate a change on your business model during the past 12 months	
Competitive intensity (Jaworski and Kohli, 1993)	Price competition Competitors starting to offer similar products/services Competitor's reactions to your initiatives
The following internal factors motivate a change on your business model during the past 12 months	
Technology turbulence (Jaworski and Kohli, 1993)	Rapid changing technology Rapid increasing technological development
How did you deal with business model innovation during the past 12 months	
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
In your enterprise, business models are. . .	
Business model practices (Ireland *et al.*, 2009; Osterwalder *et al.*, 2005)	Used to gain competitive advantages Designed in response to market circumstances Derived from enterprise's strategy
In our enterprise	
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
In our enterprise, we are very satisfied with	
Overall performance (Venkatraman and Ramanujam, 1986)	The sales growth The profit growth

To find and identify the relationship among constructs, the data set was analysed using SEM techniques. SEM is especially applicable when dealing with relationships among constructs such as in BM experimentation and subjective assessment of 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 *et al.*, 2011, p. 139). In this paper, partial least squares (PLS)-SEM method, which is a component-based estimation, is used. Table I provides a list of the items used.

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 past 24 months. Next, four specific selection questions were posed giving examples of BMI related to value proposition and market; ecosystem; IT, that is, the use of social media and/or big data; and pricing and related financial issues. The third question was used as a selection question to obtain a subsample of 338 SMEs involved in social media and big data. These questions were included to make sure firms were actually involved in BMI (Langerak *et al.*, 2004; Lee and O'Connor, 2003). Next, the key respondent from 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 questions. The questionnaire was developed in English and then translated into 11 languages (i.e. Dutch, French, Finnish, German, Italian, Lithuanian, Polish, Portuguese, Slovenian, Spanish and Swedish). The German questionnaire was used for Austria. To detect potential problems (e.g. ambiguous expressions) and cultural issues, back translation of the questionnaire into English was performed to ensure translation did not introduce any bias in the measures. Moreover, a final check on translations and consistency between them was made by a research agency. The questionnaire was pretested in every one of the 11 countries.

Data were collected 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 included in this research are spread over Europe and contain, for all European regions (North, West, Central, South and East), a large country with a large number of SMEs and a small country. Quota for micro, small and medium enterprises was established as 33, −33 and −33 per cent, respectively. No quota has been defined for industry sectors. Agriculture, public administration and nonmarket activities in households are excluded in this paper. 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, 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 was assessed. The 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

Composite reliability (CR) test examines internal consistency and reliability of latent constructs. The CR threshold is 0.70 or higher. More specifically, values between 0.60 and 0.70 are recommended in exploratory research and between 0.70 and 0.90 in other stages of research; values under 0.60 are considered lacking reliability (Hair *et al.*, 2011; Nunnally and Bernstein, 1994). Table II 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 and Bell, 2011) and recommended to be greater than 0.70 (Hair *et al.*, 2011; Urbach and Ahlemann, 2010). Statistics from Table II show that reliability of all constructs, except for one (strategy), is satisfied.

Convergent validity is presented by average variance extracted (AVE) and should be greater than 0.50 (Hair *et al.*, 2011). All of the latent constructs in Table II have sufficient convergent validity: AVE > 0.649. Factor loading accounts for nondimensionality of the 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 II Descriptive statistics, convergent validity and internal consistency and reliability of items

Construct	*Items*	*Factor loadings*	*Mean*	*SD*	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			

Notes: [a]Average variance extracted; [b]Composite reliability

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

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 Fornell–Larcker and heterotrait–monotrait ratio (HTMT) criteria for discriminant validity assessment. Table III shows that AVE value satisfies the constraints and shows that the constructs and the measuring model are adequately discriminated.

Table III Correlation among constructs and square root of the AVE

	1 BMP	*2 BME*	*3 COMI*	*4 INNAC*	*5 INNO*	*6 OPER*	*7 STR*	*8 TT*
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*

Notes: Italic values show square roots of the AVE; BMP = business model practices; BME = business model experimentation; COMI = competitive intensity; INNAC = innovation activity; INNO = innovativeness; OPER = overall performance; STR = strategy; TT = technology turbulence

The second criterion for discriminant validity assessment, HTMT, is generally 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 SEM. 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, it can be concluded that discriminant validity has not been established.

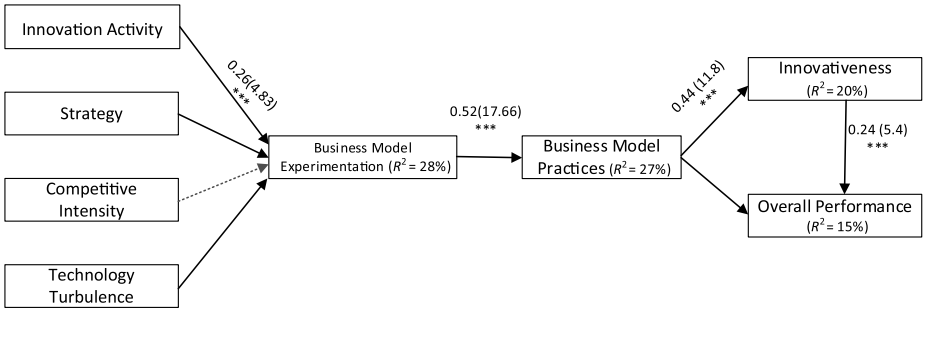
HTMT is an alternative to the classical criterion for assessing discriminant validity. Monotrait-heteromethod is the correlation of indicators measuring the same construct and heterotrait-heteromethod is the correlation of indicators across constructs measuring different phenomena. HTMT value close to 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, one can establish that discriminant validity is not an issue. Table IV shows that HTMT values satisfy even the more conservative criterion, as all the values are below 0.85.

Table IV The threshold for HTMT is based on $HTMT_{.90}$ criterion

BMP	*1 BME*	*2 COMI*	*3 INNAC*	*4 INNO*	*5 OPER*	*6 STR*	*7 TT*
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*

Notes: BMP = Business model practices; BME = business model experimentation; COMI = competitive intensity; INNAC = innovation activity; INNO = innovativeness; OPER = overall performance; STR = strategy; TT = technology turbulence

Figure 2 Results of the research model



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

Table V 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

5.3 Structural model analysis

To test the hypotheses and figure out the statistical significance of the path coefficients in the research model, SEM was used. 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 per cent, innovativeness is explained by a variance of 20 per cent and BM experimentation and practices are explained by variances of 28 per cent and 27 per cent, respectively. Figure 2 shows the relationships between constructs in the model; bold lines represent significant relationships and dotted lines insignificant relationships or unsupported hypotheses. Six different fit statistics such as 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) were computed. These model fit indices satisfy the recommended guidelines and show that our research model has a good fit with the data (Browne and Cudeck, 1993; see Table V).

5.4 Hypothesis testing

Different alternative models were tested, and the model presented in Figure 2 is the optimal model and fits best the data. Table VI shows the research hypotheses and analysis results. The results reveal significant relationships between innovation activity (β = 0.26, $p < 0.001$) and strategy (β = 0.23, $p < 0.001$) with business experimentation, thus supporting H1 and H2, respectively, in the model. The results show no significant relationship between competitiveness intensity (H3) and BM experimentation, thus not supporting H3. The analysis shows that technology turbulence drives BM experimentation and reveals a significant path (β = 0.17, $p < 0.001$), thus supporting H4 in the model.

Moreover, the results show a significant path between BM experimentation and practices (β = 0.52, $p < 0.001$), and thus supporting H5 in the model. A strong significant relationship between BM practices and innovativeness is observed (β = 0.44, $p < 0.001$), thus supporting H6 in the model. BM practices also have a significant relationship with the overall business performance (β = 0.21, $p < 0.001$), thus supporting H7 in the model. Finally, analysis shows that innovativeness has a significant relationship with overall business performance (β = 0.24, $p < 0.001$), and thus supporting H8 in the model.

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

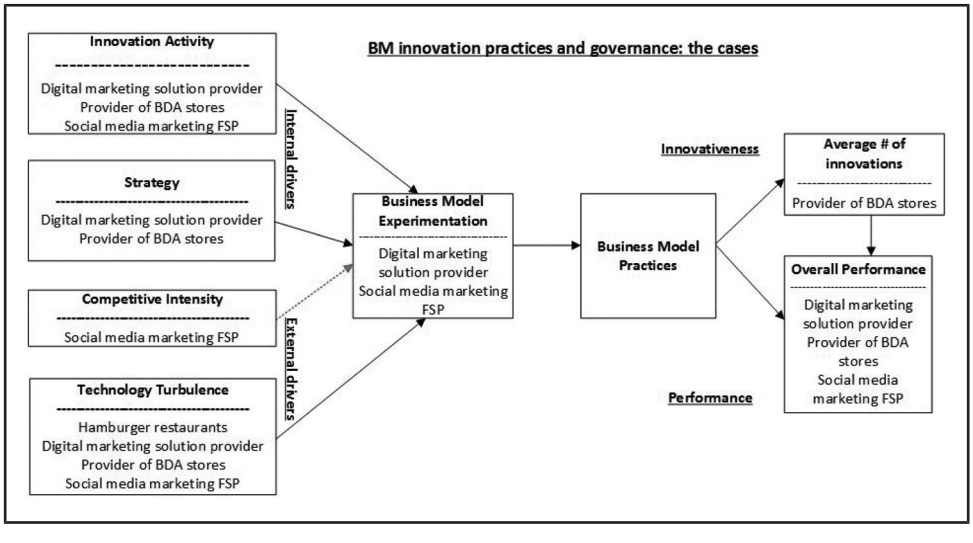
- background characteristics of the firm (information sheet);
- validation of interviews by interviewees and case reviews by other researchers involved in the project;
- assessment of the firm's strategy focus and innovativeness;
- information on factual R&D information (if available) and market focus;
- information on the value proposition and BM (innovation); and
- information on the impact of BMI on the business logic and business performance of the firm.

Depth and detail of case descriptions vary. Because 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 businesses with more than 300 years of experience) and country within Europe, a wide range of information is

Table VII Design of case studies

ICT users	*ICT producers*	
Social media	Hamburger restaurant	Social media marketing full service provider (FSP)
Big data	Digital marketing solution provider	Provider of analytics for Brick stores

Figure 3 Case studies mapped on the conceptual model



available. Moreover, the cases deal with diverse topics such as new pricing strategies for a pastry shop, the impact of servitization on the BM of a mechanical engineering firm and BM design for social innovation in health care. Thus, most of the cases are not related to digital transformation. From the total set of cases, we selected four with a clear focus on BM in combination with social media or big data to enrich the quantitative results with more in-depth insights. Theoretical sampling was used to select our cases based on two dimensions: the technology at stake, social media or big data, and whether the companies were users or producers of social media- or big data-based applications (Table VII for information on the case; Figure 3).

5.6 Case study results

1. This case is about a Spanish family business with multiple hamburger restaurants in Madrid. The second generation of owners is pushing BMI using social media. The first restaurant was opened in 1981 and is a typical American-style hamburger joint venture. Food ratings are very positive, while negative reviews were received for poor service. The owners rely strongly on a loyal customer base. The restaurant has a social media manager who uploads three to four posts per day. Social media use is not focussed on interaction with customers, but only on promotions. Based on the analyses of reviews on Facebook, Twitter and other channels such as Instagram and Foursquare, the problem of the company is mainly related to service delivery. For instance, there are long queues for the restaurant due to its poor reservation system, which relies on telephone and website reservations. People have to wait up to 1 h even if they made a telephone or online 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 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 table availability, invite people to make reservations and respond to possible service-related problems. Making use of data collected through these media, the reservation system can be optimized to reduce mismatch between reservations and table availability. From a BMI perspective, it can be concluded 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 possibilities to combine their social media presence with their in-house restaurant systems. This example illustrates how social media can be used. The 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 Spanish company is on social media marketing. Initially, the female entrepreneur started as a freelancer but later decided to offer social media marketing services. The company changed their BM from a consultancy agency to a full-service social marketing provider. They offer online marketing consultancy, social media management and content creation services. During the economic crisis in Spain, the company survived mainly due to its expertise in social media marketing. The BM components affected by the innovation were related to the change in value proposition, customer relations and key resources. Communication with clients is intensive and driven by a proactive attitude. Due to their direct communication with clients, they gain knowledge about and from their customers, which is a valuable resource also for other projects. In the back end, technical integration of the products and services offered is crucial. Communication and discussion on BMI were a continuous process within this small start-up company. Since its BMI, although operating in a very turbulent market with high competition,

the company has grown in terms of business turnover, brand awareness and client numbers. It is clear from the case that the value proposition change – as BMI –was based on social media, but this did not affect the BM fundamentally. The change from an advertisement content creator to a full-service provider was realized mainly based on market demand and acquiring knowledge on social media marketing.

3. This case relates to a consultancy and digital marketing solution provider operating in the British market. The company's main activities entail providing consultancy to boost clients' online visibility and training clients on digital marketing issues. The company is highly dependent on Google Analytics. Changes in algorithms have a huge impact on the operations and BM of the company. Due to changes in Google Analytics' algorithms, they had to adjust some components of their BM. Big data and big data analytics (BDA) could offer opportunities for this company. This change required new resources such as technological infrastructure and the company's knowledge base. The (re)use of data and the use of data from third-party providers is paramount for them. Thus, new business units were needed and established, which created a new demand and, consequently, a change in value proposition. These changes have been reflected, for instance, in the company offering training in BDA. BMI was 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 had only 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 available within stores. The company started offering customized solutions to small retail stores, which led to impressive growth rates. However, the company developed an application to improve in-store design using augmented reality offered through a large technology provider, which led to 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 services provider as well as a technology provider. This case illustrates that changes in BMs benefit companies and change their 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 BMs enables improvement of sales (channels) and optimizing of key activities.

5.7 Cross-case comparison

The four cases are mapped onto the conceptual model and 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 BM innovation experimentation and practices. Strategic considerations are mainly relevant to the big data cases, more or less suggesting that the impact of big data is based on the companies' strategic value. The social media cases suggest that in cases of both users and providers, social media played only a minor role. While social media involved collecting or disseminating information for users, know-how on social media was a key asset for providers. It is also striking that the impact of big data and BDA on companies' innovativeness and performance is also evident in big data cases compared to social media. Social media

cases showed growth, and the impact as compared to that grounded on in-depth technology know-how is less fundamental and mainly relates to application or implementation of social media. BM experimentation clearly occurs in three out of the four cases; however, strategy implementation of the new BM, to the core of BM practices, is not explicitly mentioned or discussed in all four cases. The cases partially confirm the validity of the research model.

6. Discussion

Findings from both quantitative data and 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 the BMI. The case studies show some nuances 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. Making resources and management structure available for BMI, labelled as BM experimentation, is considered important. As illustrated by both 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 strategy implementation practices in BM led to more innovations and increased performance.

The current study only gives a general picture of the relations between BMI drivers, behaviour and outcomes. The case studies offer more detail; however, more in-depth understanding of BMI is necessary. Specifically, the order in which BM components are changed needs to be studied. Understanding BMI paths and roadmaps to implement them is important for SMEs. BMI paths need to be developed for not only topics such as market expansion, internationalization and starting companies, but also how BMI works with certain technologies, that is, how BMI works when certain technologies are implemented. From the cases, it can be argued that technology characteristics play a crucial role in the incremental or radical nature of BMI. The social media cases yielded different results than the big data cases. With regard to big data and BDA, it is apparent, and discussed by the case companies, that BM experimentation has an impact on innovativeness and performance; this is not evident in the social media cases. A possible explanation is that big data is far more specialized and requires an in-depth mathematical as well as computational know-how, as well as know-how on analytics software and accompanying capabilities. Know-how in the case of social media is more related to the communication and marketing domains and therefore easier to acquire. This would also imply that the conceptual model (Figure 1) needs to be tested not for specific technologies individually.

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

From a regulatory or policy perspective, it is important to emphasize that innovation programs for SMEs should be focussed on not only traditional R&D and innovation approaches, but also BM and BMI to reap the benefits of technological and product innovations. European stimulation programs, such as SME instruments in the H2020

work program, as well as national programs should pay more detailed attention to BMI and experimentation. In the current version of the SME instrument, BMI is mentioned among 12 other topics with a main focus on hard-core technology innovation. It needs to be stressed that for all these projects, attention to BM needs to be an integral part of project proposals, not only as a scapegoat, but as a serious contribution to a project. Including analyses of digital transformation's impacts on BM is important because some forms of digital transformation, for instance, block chain or Industry 4.0, will fundamentally affect SMEs' BMs, specifically when they operate in a networked environment.

7. Conclusions, limitations and future work

Our research contributes to a better understanding of internal and external aspects of BMI and the literature on the impact of BMI on performance and outcomes, specifically when social media and big data are implied. It is important to understand how BMI occurs in organizations and how strategies are implemented in the business logic. As suggested, both quantitative as well as qualitative research on BMI matter. This paper contributes to a better understanding of how digitalization in BMI works. It offers insights into drivers and outcomes specifically for BMI driven by digitalization. However, the authors of this paper are aware that this study has only dealt with a small part of a vast area of research. In future, the aim is 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 BMI performance.

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

The research design has some limitations as well. This paper specifically focuses on companies that are knowingly of subconscious nature engaged in BMI. Research comparing companies involved in BMI and companies not engaged in BMI might provide deeper insights. In addition, measurements used in this paper were based on subjective judgments; connecting these subjective judgments with real performance data would have been interesting, but this was not possible due to European regulations in relation to research ethics and informed consent. In future research, our focus will be on collecting another wave of data 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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