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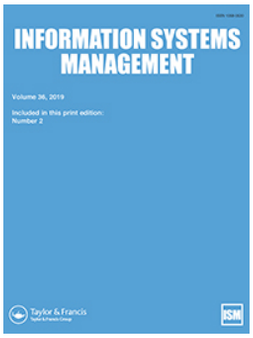

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Commoditization and IT Product Innovation Strategies from an IT Firm Perspective

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ABSTRACT
Based on a survey (N = 248 business managers) this study confirms that different types of innovation in IT products have a direct positive impact on IT firms' business performance. The commoditization level of IT markets acts as a moderator dampening this positive relationship. This implies that IT firms should take existing commoditization levels as well as a mix of IT product innovation types into account as part of their innovation strategy.

KEYWORDS
Innovation; innovation strategies; commoditization; business performance; information technology; IT industry

Introduction

Over the last few decades, the Information Technology (IT) industry has shown extensive innovation and rapid growth. Nowadays, many IT offerings are increasingly undifferentiated, price sensitive and have low switching cost. For example, today it takes less than $500 to buy a laptop with better performance, better memory, and better disk storage than a supercomputer bought for $1 million in 1985 (Hennessey & Patterson, 2012). In addition, the number of vendors offering competing IT products has grown significantly, and switching has become relatively easy. This trend is known as the commoditization of IT. According to Reimann, Schilke, and Thomas (2010): "Industry commoditization describes an increase in similarity between the offerings of competitors in an industry, an increase in customers' price sensitivity, a decrease in customers' cost of switching from one to another supplier in an industry, and an increase in the stability of the competitive structure" (p. 189). Carr (2003) expects that the commoditization of IT will lead to the consolidation of many sectors within the IT industry.

Commoditization is typically emphasized as a critical factor for companies to disappear in evolving markets (Christensen & Raynor, 2013; Olson & Sharma, 2008). For an IT firm to survive and continue to be relevant in highly commoditized IT markets, innovation is seen as a driver for major changes (Pisano, 2015; Ryan & Holmes, 2008; Weil, 2004). Today, IT firms such as Apple, Google, and Intel are examples of how innovation in IT products can drive business performance. However, there are no guarantees that innovators will be rewarded for their efforts; history provides many examples of successful innovators who failed to sustain their IT product innovations, such as Polaroid, Netscape, Xerox, Nokia, Blockbuster, and MCI WorldCom, to mention but a few (Pisano, 2015; Pisano & Teece, 2007).

The literature provides various explanations for the success or failure of IT firms (O'Reilly & Finnegan, 2013), and there are many factors that affect innovation (Kapoor, Dwivedi, & Williams, 2014). Pisano (2015) suggests that innovation strategy (or the lack of it) determines the success or failure of an IT firm. He suggests that IT product innovation today is not only about introducing new technology, but also about business models to be invented or re-invented. According to Christensen, Johnson, and Kagermann (2008): "Fully 11 of the 27 companies born in the last quarter century that grew their way into the Fortune 500 in the past 10 years, did so through business model innovation." (p. 59). Following this line of reasoning, Pisano (2015) suggests that business managers should articulate an innovation strategy that stipulates how their firm's innovation efforts will support the overall business strategy. To support this approach, he introduced a new concept called 'The Innovation Landscape Map'. This concept combines technology and business model capabilities to form four types of innovations: routine, disruptive, radical, and architectural innovation. This model can help business managers in making innovation strategy-related investment decisions.

So far, research has mainly focused on IT innovation methods; studies with generalizable empirical

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evidence on the effect of an IT product innovation strategy are lacking (Christensen et al., 2008; Pisano, 2015). What is specifically lacking is research and empirical evidence on the relationship between innovation strategy and commoditization level as well as their combined impact on business performance (Christensen & Raynor, 2013; Reimann et al., 2010). It is unclear if and to what extent the commoditization levels of IT markets should be taken into account when IT firms develop an innovation strategy.

This leads to the following research question: What is the relationship between different IT product innovation strategies and the business performance of IT firms in context of the commoditization level of the IT markets that they operate in? In contrast to most of the literature found, this study (Bronkhorst, 2016) adopts the perspective of a single IT firm to IT product innovation, instead of taking a broader market perspective. Furthermore focusing on a single IT firm enables easy access and communication with the target audience to ensure their participation and an adequate response rate within the given time constraints. Hence this study will not cover the impact of IT product innovation on IT markets nor the effect of new competitive IT products in an IT market on the IT firm.

Theoretical and practical relevance

From a theoretical perspective, this study adopts and enhances existing concepts and measurements taken from prior research to investigate innovation, commoditization and business performance. More specifically, this research has the following theoretical relevance: Firstly, to the best of our knowledge, ours is the first study to bring together the distinct research fields of innovation and commoditization. Secondly, for innovation, this is the first study to operationalize the Innovation Landscape Map proposed by Pisano (2015). This concept was adopted and enhanced because it represents the latest ideas about innovation and because it brings together technology innovation and business model innovation in a single model (Pisano, 2015). In this context we considered innovation types like process innovation, re-purposing, re-combining, non-technology-based product innovation, marketing innovation to be business model related. Alternative models are focused on either business model or technology innovation and are therefore considered to be 'incomplete' in comparison with the Innovation Landscape Map (Blank, 2013; Christensen et al., 2008; Girotra & Netessine, 2011; Gunday, Ulusoy, Kilic, & Alpkan, 2011). Finally, as no literature was found on measuring commoditization in the IT industry, the current study leverages the concept and measurement of an industry's level of commoditization as discussed by Reimann et al. (2010) for first-time use in the IT industry.

Theoretical framework

Innovation strategy and types of innovation

Damanpour, Szabat, and Evan (1989) define innovation as "the adoption of an idea or behavior – whether pertaining to a device, system, process, policy, programme, product, or service – that is new to the adopting organization" (p. 588). Empirical findings reported by Hult, Hurley, and Knight (2004), in a study across 1000 firms with sales above US $100 million per year, confirm innovativeness as an important determinant of business performance, regardless of the market turbulence in which the firm operates. Hence, they advice that "management should seek to be innovative and maintain a continuous state of innovativeness" (p. 436). Gunday et al. (2011) found that innovation strategy is an important major driver of firm performance and should be developed and executed as an integral part of the business strategy.

The current study employs the novel concept of the Innovation Landscape Map as defined by Pisano (2015) and which consists of four innovation types that are defined as follows:

Firstly, routine innovation builds on a company's existing technological competences and fits with its existing business model – and hence its customer base. Examples of routine innovation include next generation CPUs, new versions of existing servers, and enhanced networking products. Secondly, disruptive innovation requires a new business model but not necessarily a technological breakthrough. For that reason, it also challenges, or disrupts, the business models of other companies. This can be done, for example, by providing video on demand, flexible capacity services or platform-as-a-service. Thirdly radical innovation is the polar opposite of disruptive innovation. The challenge here is purely technological. Examples are new system-on-a-chip technology, persistent memory, cartridge-based servers, and photon-based communication products. Fourthly, architectural innovation combines technological and business model disruptions. Examples include digital imaging that impacts photography business, internet searches that impact encyclopedia sales, and blockchain solutions that impact financial services.

Although there is literature about innovations, we did not find specific literature about the individual innovation types as defined by Pisano within the Innovation Landscape Map. More specifically the processing of literature on the four innovation types within the

Innovation Landscape Map revealed inconsistent and even conflicting definitions for three of the four innovation types (Abernathy & Clark, 1985; Christensen, 1997; Clark & Henderson, 1990). Only routine innovation (often referred to as incremental innovation) proved to be consistently defined and used across the literature studied for this research (Christensen et al., 2008; Clark & Henderson, 1990; Pisano, 2015). Radical innovation for example, is defined by Pisano (2015) as well as by Dewar and Dutton (1986) as purely technological, whereas Boutellier and Heinzen (2014) define radical innovation as innovation "to create fundamentally new businesses, products and processes and new combinations thereof" (p.2), which suggests a larger scope that goes beyond technology innovation. Another example is provided by Bourreau, Gensollen, and Moreau (2012), who use radical and disruptive innovation as synonyms for major technological innovations. This suggests that research on innovation strategy for business model and technology types of innovation is at a relatively low level of maturity, lacking a consistent and common set of definitions. This also implies that measurement of the innovation types within the Innovation Landscape Map requires development of a new questionnaire and may be challenging, especially for radical, disruptive, and architectural innovation.

Impact of innovation types on business performance

Various factors can be distinguished that impact firm performance (Zhang, Zhao, & Kumar, 2016), and the current study used the business performance measurements developed by Morgan and Vorhies (2005). It is inspired by the business scorecard introduced by Kaplan and Norton (1996) and commonly used within the IT industry, enhances the approach proposed by Hult et al. (2004) by including customer satisfaction (besides market effectiveness and profitability), and has been applied in recent research (e.g. by Reimann et al., (2010)).

A large number of studies on the relationship between innovation and business performance suggest a positive impact of higher innovativeness on business performance (Damanpour et al., 1989; Gunday et al., 2011; Hult et al., 2004). Often, these studies are conceptual (Damanpour et al., 1989), focus on different types of innovation (Gunday et al., 2011), adoption (Carter, Weerakkody, Phillips, & Dwivedi, 2016), business performance (Ashrafi & Mueller, 2015), and/or use different business performance measures (Hult et al., 2004). The most common innovation types examined are process and product innovation (Gunday et al., 2011).

Although the relationship between innovation and business performance is intuitively appealing, there are also studies indicating a negative link or no link at all (e.g. Chandler & Hanks, 1994; Subramanian & Nilakanta, 1996). Rosenbusch, Brinckmann, and Bausch (2011) indicate that the innovation–performance relationship is context dependent. Factors such as the age of the firm, the type of innovation, and the cultural context affect the impact of innovation on firm performance to a large extent.

As indicated in the previous section, a consistent and common set of definitions for the four innovation types within the Innovation Landscape Map is lacking. Hence literature review and hypotheses development are looked at through the lens of technology innovation and business model innovation as these are uniquely combined within the Innovation Landscape Map.

Miller (2001) states that most firms seek technology innovation to gain competitive advantage in their markets. This is complemented by Carr (2003), who argues that IT can be used to supplement and improve strategy implementation. Lee, Song, Baker, Youngjin, and Wetherbe (2011) indicate that the strategic emphasis placed on IT may be increasing, but that its association with firm performance is declining. Their research suggests that the routine and radical innovation types from the Innovation Landscape Map have a positive effect on business performance. More or less, innovation or routine innovation is necessary because the economic value of a technology remains latent until it is commercialized, and the same technology commercialized in different ways will yield different returns (Chesbrough, 2003). Christensen (2003) indicates that many of the most profitable growth trajectories in history have been initiated by disruptive innovations and that successful new-growth builders know – either intuitively or explicitly – that disruptive strategies greatly increase the chances of competitive success. Hence the following technology innovation capabilities related hypotheses will be investigated:

H1. Routine innovation increases the business performance of IT firms.

H2. Disruptive innovation increases the business performance of IT firms.

A more recent research theme is focused on business model or architectural innovation (Blank, 2013; Christensen et al., 2008; Dmitriev, Palmer, Schneckenberg, Simmons, & Truong, 2014; Girotra & Netessine, 2011; Manzi & Thomke, 2014). This kind of innovation has a positive impact on business

performance, which is evidenced (as was mentioned above) by the fact that in the past decade, 11 of the 27 companies born in the last quarter of the 20th century found their way into the Fortune 500 through business model innovation (Christensen et al., 2008). For the current study, this led to the following business model capabilities related hypotheses:

H3. Radical innovation increases the business performance of IT firms.

H4. Architectural innovation increases the business performance of IT firms.

Commoditization of IT

A recurring research theme concerns efforts to cope with commoditization and beat its effects. Reimann et al. (2010) conducted research on how the level of commoditization in an industry affects the effectiveness of marketing strategies. Their work revealed that commoditization is a moderator in the relation between marketing strategies and business performance across various industries. Their study shows that as commoditization increases, operational excellence and product leadership lose impact, while customer intimacy becomes a more vital performance driver. Weil and Utterback (2005) expanded this research by developing a system model for analyzing the fundamental dynamics of innovative industries. They incuded innovation in the system model; commoditization is modeled as a 'market maturity stage'. IT market-specific examples of commoditization include commoditization of hardware platforms (Hardware Platform Suppliers are Squeezed, 1993), high-performance storage (Studham, 2004), and the commoditization of IT services with cloud computing (Muhss, Neumann, & Schmietendorf, 2011).

The literature confirms that commoditization is a fact of life in different IT markets and that this is an ongoing concern (Hardware Platform Suppliers are Squeezed, 1993; Muhss et al., 2011; Studham, 2004). The specific characteristics used to describe commoditization vary, although price sensitivity and declining margins are mentioned in all articles reviewed (Worldwide PC Market, 2011). Reimann et al. (2010) addressed – amongst other things – the need for a commonly accepted conceptualization and operationalization of an industry's level of commoditization. As a result, four distinctive aspects of commoditization were identified: product homogeneity, price sensitivity, switching cost, and industry stability. Boutellier and Heinzen (2014) indicate that routine innovation is typically about cost or feature improvements in existing products, services, and processes for current markets. This implies limited change in a relatively stable environment where competitors offer increasingly homogenous products to price-sensitive customers who incur relatively low costs in changing suppliers. This is the definition of commoditization used by Reimann et al. (2010).

Halpern and Vasiliadis (2009) indicate that once basic technology barriers have been overcome, the time-to-market is drastically reduced, a new high-value product is likely to be commoditized almost instantaneously, and the time to recoup investments on new products is shortening. In addition, the researchers state that it will be difficult to convince shareholders to accept high commodity-like margins when trying to compete solely on a high commodity level and adopt a high commodity-directed strategy. Pisano (2015) argues that in much of the writing on innovation today, routine innovation is denigrated as myopic at best and suicidal at worst. At the same time, he states that this line of thinking is simplistic as the vast majority of profits are created through routine innovation. To illustrate: since Intel launched its last major disruptive innovation (the i386 chip) in 1985, it has earned more than $200 billion in operating income, most of which has come from next-generation microprocessors (Pisano, 2015).

Research by Reimann et al. (2010) showed that the positive relationship between product leadership and firm performance is weaker in highly commoditized industries than in less commoditized industries. This is because commoditization characteristics, like high product homogeneity, leave only marginal room for product variation. High industry stability, and thus a low rate of product innovation, provides less opportunity to differentiate in terms of new product features. This line of reasoning suggests that routine innovation will be a less relevant business performance driver in more commoditized IT markets than in less commoditized IT markets. Hence, the following hypothesis is proposed:

H5. The positive relationship between routine innovation and business performance is weaker in highly commoditized IT markets than in less commoditized IT markets.

Scholars frequently refer to radical and/or disruptive innovation as the keys to success in 'beating commoditization'. Radical, disruptive, and architectural innovations are viewed as the keys to growth, which implies increased competitive differentiation, bigger margins

and an environment in which it is more difficult for customers to change suppliers (Pisano, 2015). Boutellier and Heinzen (2014), for example, indicate that radical innovation is about changing the market thoroughly. Clark and Henderson (1990) advance the idea that some innovations are 'architectural' in nature, based on a reconfiguration of existing organizational and technological capabilities. They also state that architectural innovation presents established organizations with subtle challenges (such as recognizing what is useful and what not as well as acquiring and applying new knowledge when necessary) that can have significant competitive implications.

With radical innovation, new technology is introduced by using existing business models which can disrupt a mature or highly commoditized industry or market and change its dynamics (Weil, 2004).

Architectural innovation combines technological and business innovation. Abernathy and Clark (1985) argue that this type of innovation renders existing technological competence obsolete while creating new customer linkages. Christensen (1997) states that architectural innovation tries to build or find a new market that is in favor of new disruptive technology. A study conducted by Gunday et al. (2011) has found that higher innovative performance improvement results in improved production and market performances. Against this background, the following is hypothesized:

H6. The positive relationship between disruptive innovation and business performance is stronger in highly commoditized IT markets than in less commoditized IT markets.

H7. The positive relationship between radical innovation and business performance is stronger in highly commoditized IT markets than in less commoditized IT markets.

H8. The positive relationship between architectural innovation and business performance is stronger in highly commoditized IT markets than in less commoditized IT markets.

Method

Sample

Data were collected by means of an online survey held among 1,595 business managers, partner managers, product champions and presales resources with deep business knowledge on both products and related markets from IT firm Hewlett Packard Enterprise (HPE) and conducted from February 2016 until May 2016. This sample was selected because this concerned a homogeneous group which was accessible for the researcher. This groups is homogenous in the sence of business and marketing strategy, organizational functions and standardization of processses across regions. Using a homogenous group reduces the amount of confounding variables (or factors) that may affect the results of this study. However, a disadvantage of this sampling strategy is that it may affect the generalization of the results to other kind of companies.

In addition there is reason to believe that all four types of innovation from the Innovation Landscape Map are represented within HPE. Routine innovation is for example reflected through next generation CPUs, new versions of existing servers and enhanced networking products, while Radical innovation is demonstrated by new persistent memory (HPE Memristor), cartridge based servers (e.g. HPE Moonshot) and photon based communication products (e.g. X1 photonic interconnect technology). Disruptive innovation on the other hand is shown by new offerings such as providing on-premises managed infrastructure on a pay-per-use basis (HPE flexible capacity services), new IT consumption models such as HPE flexible asset return as well as highly outsourced supply chain innovations for manufacturing HPE products. Architectural innovation is for example represented through new memory-driven computer architecture development (the Machine) within HPE Labs that is focused on providing a quantum leap in compute performance and energy efficiency, providing the ability to extend computation into new workloads as well as speed analytics, high performance computing (HPC) and other existing workloads. HPE Labs development of HPE Enterprise grade distributed ledger solutions (based on block chain technology) is another example within architectural innovation. The various types of innovations were found within HPE as shown in Table 1. The table shows that all types of innovation from the Innovation Landscape Map were represented within HPE.

The online survey resulted in 248 useful responses after the data had been cleaned (responses were excluded when they had missing values or they responded to all items using the same score or when they were from the same person). The sample covered HPE employees with a responsibility for and/or deep business knowledge of 27 product lines in 4 product categories and their related IT markets. Typical positions included those held by country managers, business (category) managers, partner managers, (HPE external) product champions, and various presales functions. The complete initial sample covered 10 regions in Europe, the Middle-East, and Africa (EMEA) as well as 7 regions in Asia Pacific and Japan

Table 1. Example of innovations within HPE based on Pisano's classifications.

	Leverages existing technical competences	Requires new technical competences
Requires new business models	**Disruptive innovation** -on-premises managed infrastructure on a pay-per-use basis (HPE flexible capacity services) -new IT consumption models such as HPE flexible asset return as well as highly outsourced supply chain innovations for manufacturing HPE products	**Architectural innovation** -new memory-driven computer architecture development (the Machine) -high performance computing (HPC) and other existing workloads -Distributed ledger solutions (HPE Enterprise grade)
Leverages existing business models	**Routine innovation** -next generation CPUs -new versions of existing servers and enhanced networking products	**Radical innovation** -new persistent memory (HPE Memristor) -cartridge based servers (e.g. HPE Moonshot) -photon based communication products (e.g. X1 photonic interconnect technology)

Table 2. Demographics.

Target group and region	Qualified responses	Breakdown per region	Percent Qualified responses	Breakdown per product category	Percent Qualified responses
Business Managers EMEA	43	Central Eastern Europe & Israel (CEEI)	11.7	Integrated Systems	29.0
Distributor Sales Managers EMEA	32	Germany	15.3	Networking	14.1
Channel Partner Sales Managers EMEA	17	Great Western Europe (GWE)	14.5	Servers	31.5
Presales EMEA	156	UK & Ireland (UKI)	16.1	Storage	25.4
Business Managers APJ	0	Europe, Middle-East and Africa (EMEA)	42.3		
Total	248	Total	100% (= 248)		100% (= 248)

(APJ) while the qualified responses covered only 5 regions in EMEA and 4 product categories with corresponding IT markets. Table 2 provides an overview of demographic data of this research.

Measures

The statistical software packages SPSS v24, add-on module PROCESS, and Amos v23 were used for an analysis of the data. The first-order constructs in this research are innovation types, commoditization level and business performance. Validated questionnaires were used for commoditization level and business performance, while new items were developed for the innovation types from the Innovation Landscape Map: routine, radical, disruptive, and architectural innovation (Pisano, 2015). Reason for developing new items was because no existing measurements for these innovation types could be identified from prior research, as was also recognized by Pisano in a personal e-mail dated 7 January 2016. Pisano subsequently suggested literature for developing a new questionnaire (Abernathy & Clark, 1985; Christensen, 1997; Clark & Henderson, 1990; Pisano, 2015). Five new items were developed for each innovation type based on these literature pieces which are all assumed to be equally foundational for the Innovation Landscape Map and using a five-point Likert scale comparable with the other measurements (see Appendix for the questionnaire and with each item referencing its source). On the basis of the EFA results (obtained in accordance with the guidelines formulated by Osborne and Costello (2009)), it was decided to continue with just two types of innovation: routine innovation as defined above and game changing innovation as the consolidation of radical, and architectural innovation. The survey was held within a single company (HPE) and from this perspective the constructs are endogenous. This research focused on IT company specific IT product innovation and did not measure the impact of innovation types on the markets nor the effect of market development on innovation within the IT company.

Measures for commoditization level were adopted from the work of Reimann et al. (2010) as they indicate to be the first ones to conceptualize and operationalize an industry's level of commoditization, but did not apply this to the IT industry. The final model based on CFA, with the second order latent factor commoditization level measured by two first-order latent factors (price sensitivity and switching cost), showed good model fit: $\chi^2/df = 2.291$, CFI = .960, TLI = .940, RMSEA = .072 and SRMR = .0513. As a result of this CFA, it was concluded that commoditization level consisted of price sensitivity and switching cost. Product homogeneity and industry stability were left out. Business performance measures were adopted from Morgan and Vorhies (2005). Business performance was viewed as a reflective construct with the following dimensions: customer satisfaction, market effectiveness, and profitability. Each dimension was measured using three items and a five-

point Likert scale. This scale was used because the items that were leveraged from other research originally also used a five-point response scale and it was considered important to keep consistency between questionnaires to make results comparable. A second-order CFA was used, which resulted in a good model fit: $\chi^2/df = 2.015$, CFI = .967, TLI = .956, RMSEA = .064, and SRMR = .0425.

Findings

Descriptive statistics

To be able to use the constructs in a moderation analysis, the values of the constructs were calculated on the basis of the mean of the value of the observed items. Table 3 provides an overview of the descriptive statistics and correlations between the main constructs.

Commoditization level as a moderator

Moderation analyses were carried out using regression analysis in PROCESS 15 for SPSS, following Hayes (2013) and (Cohen, Cohen, West, & Aiken, 2003).

Commoditization and routine innovation

Firstly, we investigated the moderating effect of commoditization level on the relationship between routine innovation and business performance. Table 4 shows a direct relationship between routine innovation and business performance (B = .45, p < .001), but no relationship between commoditization level and business performance (B = −.05, p = .34). The moderation analysis shows a significant effect (p = .04) of the interaction term (B = −.18) on business performance. This indicates that commoditization level is a moderator for the relationship between routine innovation and business performance.

Figure 1 shows how commoditization level dampens the positive relationship between routine innovation and business performance. In other words, when the levels of commoditization are high, the positive relationship between routine innovation and business performance is weaker than when the levels of commoditization are low.

Table 4. Moderating role of commoditization level on the relation between routine innovation and business performance.

	R	R^2	F	B
Business Performance				
Model statistics	.49	.24	25.82	
Routine innovation				.45***
Commoditization level				−.05
Interaction (INT_1)				−.19*

N = 248, * p < .05, **p < .01, ***p < .001

With respect to the factor analysis, commoditization level has two subvariables: price sensitivity and switching cost. In order to better understand the contributions of these two factors towards the moderating effect, analyses were repeated with each of these two factors acting as a moderator between routine innovation and business performance. It was found that the moderation analyses for price sensitivity showed a significant effect of the interaction term on business performance (B = −.17, p = .04), while for switching cost no significant effect of the interaction term on business performance was seen (B = −.09, p = .18). Therefore, the main contributor for the moderation effect of commoditization on the relationship between routine innovation and business performance is price sensitivity. This means that when price sensitivity is high, the positive relationship between routine innovation and business performance is weaker than when price sensitivity is low.

Given that one of the key consequences of commoditization is that of reduced profit margins and, thus, profitability, the impression might arise that there is an important first-order direct relationship between commoditization and business performance. Commoditization level however is measured through price sensitivity and switching cost, while business performance is not only measured through profitability, but also by market effectiveness and customer satisfaction. And as moderators must have an interaction effect with the dependent variable, a correlation of −.17 is not indicating too much overlap between the concepts of commoditization level

Table 3. Descriptive statistics and correlations.

Variable	M	SD	1	2	3a	3b	3c	3	4a	4b	4
1. Routine innovation	4.05	.60	(.71)								
2. Game changing innovation	3.82	.71	.45**	(.90)							
3a. Customer satisfaction	3.83	.65	.44**	.37**	(.87)						
3b. Market effectiveness	3.53	.74	.40**	.45**	.63**	(.84)					
3c. Profitability	3.50	.63	.40**	.34**	.72**	.64**	(.78)				
3. Business performance	3.62	.59	.47**	.44**	.88**	.87**	.88**	(.85)			
4a. price sensitivity	3.39	.82	−.08	−.01	−.10	−.08	−.15*	−.12	(.76)		
4b. Switching cost	2.80	.86	−.09	−.03	−.12	−.01	−.13*	−.10	.49**	(.80)	
4. Commoditization level	3.10	.53	−.04	−.13*	−.16*	−.12	−.16*	−.17**	.71**	.77**	(.70)

N = 248. Cronbach's alphas are reported on the diagonal in parentheses. * p < .05, ** p < .01

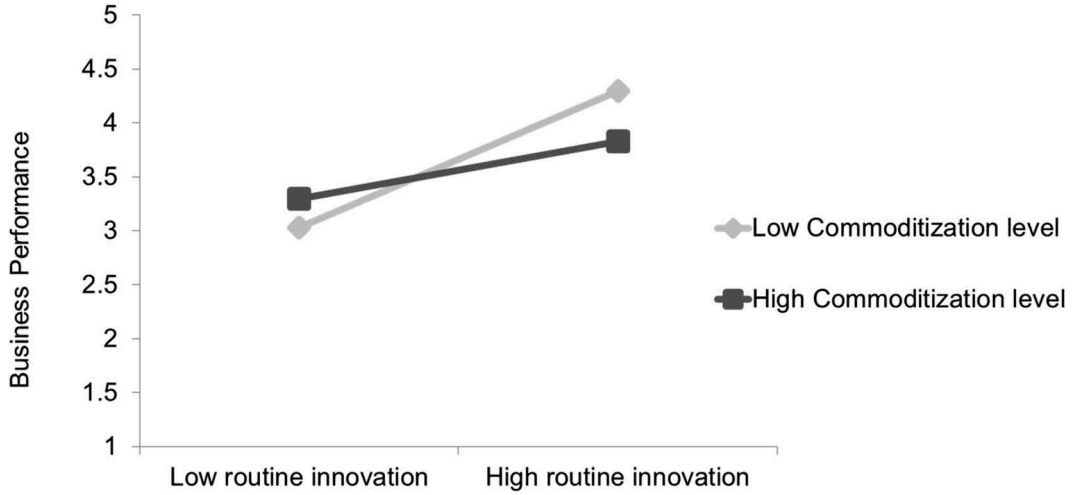

Figure 1. Interaction effect between routine innovation and business performance.

and business performance. Hence it is assumed that commoditization level is measured sufficiently different from business performance to be able to separate out the moderating influence.

Commoditization and game changing innovation

Table 3 shows a direct relationship between game changing innovation and business performance (B = .36, p < .001). No relationship was found between commoditization level and business performance (B = −.09, p = .09). Table 5 also shows a significant effect (p = .04) of the interaction term (B = −.12). This suggests that commoditization level is a moderator for the relationship between game changing innovation and business performance.

Figure 2 shows how commoditization level dampens the positive relationship between game changing innovation and business performance. In other words, when the levels of commoditization are high, the positive relationship between game changing innovation and business performance is weaker than when the levels of commoditization are low.

Here, too, the moderation analysis was repeated for price sensitivity as well as switching cost, with each acting as a moderator between game changing innovation and business performance. As a result, the moderation analyses for price sensitivity showed a significant effect of the interaction term on business performance (B = −.13, p = .01), while for switching cost no significant effect was seen of the interaction term on business performance (B = −.07, p = .15). It can therefore be concluded that the main contributor for the moderation effect of commoditization on the relationship between game changing innovation and business performance is price sensitivity.

Table 5. Moderating role of commoditization level on the relation between game changing innovation and business performance.

	R	R^2	F	B
Business Performance				
Model statistics	.47	.22	22.28	
Game Changing innovation				.36***
Commoditization level				−.09
Interaction (INT_1)				−.12*

N = 248, * p < .05, **p < .01, ***p < .001

Findings

In answering the main research question ("What is the relationship between different types of innovation strategies in IT and the business performance of IT firms with various levels of IT commoditization?"), it was concluded that both routine and game changing innovation have a direct positive impact on the business performance of IT firms. Routine innovation occurs when new IT offerings (e.g. new releases of existing IT infrastructure products) are developed based on existing business model and technology capabilities (i.e. "more of the same"). The typical aim of routine innovation is to incrementally improve the IT firm's competitive position and business performance within an existing market. Game changing innovation introduces new offerings (e.g. innovative delivery of infrastructure-as-a-service) based on new business model and/or technology capabilities with the goal of developing new IT markets and making revolutionary steps in the competitive positioning and business performance of an IT firm (i.e. "changing the game"). This study shows that both have a positive effect on business performance (B = .45 and .36, respectively), meaning

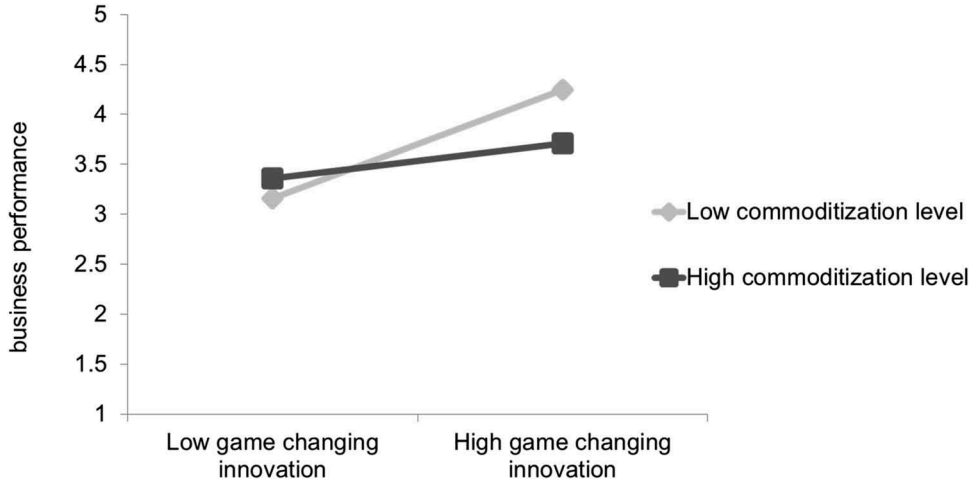

Figure 2. Interaction effect between game changing innovation and business performance.

that this study supports Hypotheses 1–4 (H1 Routine, H2 Disruptive, H3 Radical, H4 Architectural innovation increases the business performance of IT firms). This confirms earlier research as reported by Damanpour et al. (1989), Gunday et al. (2011), Hult et al. (2004) and to name but a few examples.

Furthermore, it can be concluded that IT commoditization level acts as a moderator with a dampening effect on the positive relationship between different types of innovation and business performance. The moderation analysis revealed a significant effect (p = .04) of the interaction term for routine innovation x commoditization level (B = −.18) on business performance. In a similar vein, a significant effect (p = .04) was found for game changing innovation x commoditization level (B = −.12) on business performance. This means that in highly commoditized IT markets (e.g. servers or storage), the positive contribution of routine and game changing innovation towards business performance is weaker than in IT markets where commoditization is low (e.g. networking or integrated systems). This supports Hypothesis 5 (The positive relationship between routine innovation and business performance is weaker in highly commoditized IT markets than in less commoditized IT markets). However, the findings do not support Hypotheses 6–8 (The positive relationship between (H6) disruptive, (H7) radical or (H8) architectural innovation and business performance is stronger in highly commoditized IT markets than in less commoditized IT markets).

With respect to routine innovation, the findings of the current study are confirmed by Reimann et al. (2010), suggesting that routine innovation (i.e. "more of the same") in a stable IT market with undifferentiated products that are price sensitive and have low switching cost (i.e. that are highly commoditized) will make it difficult for an IT firm to sustain or even grow its business performance. The reason for this is that high commoditization level characteristics leave only marginal room for product variation; this provides less opportunity to differentiate with new product features (Reimann et al., 2010). In contracts for game changing innovation, results are contradictory. Game changing innovation introduces completely new offerings and differentiation through technology innovation and/or business model innovation (Abernathy & Clark, 1985; Christensen, 1997; Pisano, 2015). Hence, it was expected that the positive relationship between game changing innovation and business performance would be stronger in highly commoditized IT markets than in less commoditized IT markets. This was not found in this study.

Commoditization level was only measured by two (financial) factors: price sensitivity and switching cost (based on CFA, market stability and product homogeneity were removed). The moderation analyses were repeated with each of these two factors. With respect to price sensitivity for both types of innovation, the results showed a significant effect of the interaction term on business performance (B = −.17, p = .04); with respect to switching cost, no significant effect was found of the interaction term on business performance (B = −.09, p = .18). It can therefore be concluded that the main contributor towards the moderation effect of commoditization on the relationship between, respectively, routine and game changing innovation and business performance is price sensitivity. In highly commoditized IT markets (that is to say markets with high price sensitivity), the positive contribution of routine and game changing innovation towards business performance is weaker than in IT markets where commoditization is low.

Discussion

This study offers several contributions to existing literature. First, a new questionnaire was developed for assessing four innovation types based on the Innovation Landscape Map designed by Pisano (2015). The survey data were found to show validity and reliability for routine innovation, but for radical, disruptive, and architectural innovation they were found to be too much correlated. As a result, these three innovation types were treated as a single innovation type termed game changing innovation. This is in line with the literature, where only routine innovation is consistently defined (Alpkan, Gunday, Kilic, & Ulusoy, 2011; Chesbrough, 2003; Pisano, 2015); the other innovation types are used with varying definitions (cf. Bourreau et al., 2012; Boutellier & Heinzen, 2014; Pisano, 2015). Another justification lies in the use of a homogeneous sample within a single IT firm, which might be biased when it comes to recognizing different innovation types. It is recommended to conduct more in-depth research to further develop the questionnaire, although it can be used to assess two innovation types – routine and game changing innovation – as an abstraction of the Innovation Landscape Map.

Secondly, the current study was the first to use the commoditization level construct proposed by Reimann et al. (2010) in the IT industry. It found evidence for two dimensions, namely price sensitivity and switching cost, but not for product homogeneity and market stability, two other dimensions of the commoditization level construct designed by Reimann et al. (2010). An explanation for this finding might be that the current study was conducted in the IT market, which is a single industry, whereas the study carried out by Reinman et al. was focused on multiple industries. A second explanation can be found (again) in the homogeneous nature of the sample used in this study; the sample primarily included a relative homogenous group of business managers, and these might have been biased towards financial performance or may not have recognized the (other) dimensions of the commoditization construct.

Thirdly, while literature presents contradicting viewpoints on the impact of innovation on business performance, the empirical survey results for hypotheses 1–4 clearly show that both routine innovation (e.g. new releases of existing IT infrastructure products) as well as game changing innovation (e.g. the innovative delivery of infrastructure-as-a-service through flexible capacity services) will make a positive contribution towards business performance. This confirms earlier research which indicates that both technology as well as business model innovations have an impact on business performance-related factors such as customer satisfaction, market effectiveness (incl. competitive positioning), and profitability (Gunday et al., 2011).

Finally, the empirical survey results for hypothesis 5 demonstrate that commoditization level is a moderator for the positive relationship between routine and game changing innovation and business performance. In highly commoditized IT markets (e.g. servers or storage), the positive contribution of routine and game changing innovation towards business performance is weaker than in IT markets where commoditization is low (e.g. networking or integrated systems). This finding was expected for routine innovation. Current findings are confirmed by literature that suggests that routine innovation (i.e. "more of the same") in a stable IT market with undifferentiated products that are price sensitive and have low switching cost (i.e. products that are highly commoditized) will make it difficult for an IT firm to sustain or even grow its business performance (Carr, 2003).

Study findings are in contrast with literature as well as hypotheses 6–8 where the positive contribution of game changing innovation towards business performance was suggested to be stronger in highly commoditized markets than in markets where commoditization is low (Carr, 2003; Pisano, 2015; Weil, 2004). An explanation for this deviation can be found in the way in which commoditization level was measured in this research (i.e. through price sensitivity and switching cost) and/or by the homogeneous nature of the sample, as a result of which the different types of innovation and their effects may not have been recognized.

Implications for practice

The findings suggest a number of specific actions to be undertaken by IT firms. A first recommendation is that these firms should invest in systems and processes for assessing different innovation types and commoditization levels in the IT markets in which they operate. Having these systems and processes in place will provide business managers with data and insights that are needed to develop an innovation strategy and make decisions to improve business performance while taking the commoditization level of various IT markets into account. Such an environment can be used not only to determine an innovation roadmap for future releases of infrastructure products, but also to validate this roadmap in the context of a predicted commoditization level trend within the targeted IT market(s). More specifically an owner for these systems and processes should be assigned and while using a pragmatic

approach, the questionnaire as well as the survey and analytics tools used for this study could be used as a starting point.

A second recommendation that can be formulated on the basis of this study is that IT firms facing increasing commoditization should assess their investments in routine innovation and determine whether and how they want to scale back. As IT markets become more commoditized, routine innovation becomes less important for improving business performance. This could imply for an IT firm, for example, a need to reduce the number of different server and storage products as their associated IT markets become highly commoditized while additional investment is put into standardized infrastructure-as -a-service offerings (i.e. business model innovation). Another example is to consolidate more server-, storage- and networking products into integrated solutions that are positioned in adjacent IT markets and could e.g. uniquely differentiate themselves by providing increased efficiency for specific applications. Realizing this second recommendation provides an innovator's dilemma (Christensen & Raynor, 2013). Should we invest to protect the least profitable end of our business, so that we can retain our least loyal, most price-sensitive customers? Or should we invest to strengthen our position in the most profitable tiers of our business, with customers who reward us with premium prices for better products?

A third recommendation is that an IT firm's innovation strategy should contain a combination of technology and business model innovation. The advantages of such a mix are that investments as well as the risk of innovation failures are spread across multiple innovation initiatives while business performance is improved in increasingly commoditized IT markets. This could, for example, be applied to a fundamental innovation of new computer architectures, not only in terms of introducing new technologies such as persistent memory, photon communications, and systems-on-a-chip, but also in terms of enabling new business models such as fraud analytics-as-a-service or a service to resolve the 'traveling salesman problem': finding the fastest way to visit all the cities in a given territory. The current study suggests that both technology innovation and business model innovation are of major importance, regardless of the market's commoditization level. The key would be to strive for a balanced innovation approach that takes the commoditization level into account while improving business performance.

Conclusion

This study indicates that different types of innovation in IT products have a direct positive impact on the business performance of IT firms and shows that the commoditization level of IT markets (especially price-sensitive markets) acts as a moderator dampening the positive relationship between different types of IT product innovation and business performance. In commoditized IT markets, an innovation strategy that is balanced across different types of innovation is critical to driving business performance. However, as IT markets are becoming more commoditized, a reduced routine innovation focus within that IT market as well as a balance between routine and game changing innovation seem to have the greatest impact on performance. This implies that IT firms should take into account both existing commoditization levels and a mix of IT product innovation types as part of their innovation strategy. Study findings suggest that IT firms would be wise to invest in systems and processes for assessing different innovation types and commoditization levels in the IT markets in which they operate. In sum, the findings emphasize that a commoditization assessment should become a vital part of an IT firm's efforts to address innovation and survive in commoditized IT markets.

Limitations and future research

Altough the findings in this study are subject to a few limitations, various suggestions can be made for future research. Firstly, the homogeneity of the sample used in the present study (i.e. HPE business managers) raises questions regarding the generalizability of the findings, namely whether the results would also hold for business managers in other IT firms. While the IT products from different IT firms are increasingly commoditized, business models are changing rapidly as the IT markets are moving towards becoming more service oriented. As a result, business managers from other IT firms might hold different perspectives on business model innovation. This will lead to differences in interpretation with respect to the innovation types distinguished in the Innovation Landscape Map. Future research can help to complement the relationships found in this study with a more granular understanding of the impact of different innovation types, potentially leading to more refined guidelines.

Secondly, although this study considers the commoditization level in IT markets as a moderator, it does not incorporate other potential moderators. Next to that the survey was held within a single company (HPE) and from this perspective the constructs are endogenous. Another limitation is that we only used survey data and we did not investigate the impact of actual market developments and innovations on an IT firm. Future research may aim for a more complete

representation of relevant contingencies, including the IT firm's resources and capabilities (see Ashrafi & Mueller, 2015), an outside-in market innovation perspective (Boudreau & Lakhani, 2011) as well as certain characteristics of the firm's top management team.

Thirdly, in hindsight we can conclude from the validity analysis that the Innovation Landscape Map appears not to reflect the current way of thinking about innovation (types). We think this might be caused by overlapping innovation types. As a result this study was limited to cover only two innovation types; routine- and game changing innovation. Future research should further validate the conceptual model with the use of other innovation types.

Fourthly, while the commoditization level construct and operationalization were leveraged from the earlier work of Reimann et al. (2010), the product homogeneity and industry stability had to be dropped after validity analysis. This raises questions about the applicability of this construct in other studies. Hence it is recommended for future research to further investigate and develop the dimensions and operationalization of the commodization level construct.

Finally, an important proposition of the Innovation Landscape Map – Pisano's recommendation (2015) "In thinking strategically about the four types of innovation, the question is one of balance and mix" (p. 10) – has not been explored in this research. Nevertheless, the results suggest that a mix will likely contribute to business performance and that this mix should take commoditization levels into account. Future research should examine whether certain threshold levels exist that must be exceeded for all innovation types to achieve success.

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Appendix Questionnaire

Innovation strategy (between brackets the source of the item)

To what extent do you agree with the following statements?
1 = fully disagree, 2 = somewhat disagree, 3 = neutral, 4 = somewhat agree, 5 = fully agree

Routine innovation

(1) My product line uses an established design that is continuously refined and extended (Clark & Henderson, 1990)
(2) Innovation in my product line leverages existing technological competences and existing business models (Pisano, 2015)
(3) Innovation in my product line strengthens the relationship with established customers while conserving existing technological competences (Abernathy & Clark, 1985)
(4) Innovation in my product line reinforces the competitive position of my company and builds on existing core competences (Clark & Henderson, 1990)
(5) Innovation in my product line improves the performance of established products (Christensen, 1997)

Radical innovation

(6) Innovation in my product line periodically changes the market radically through new technology (Boutellier & Heinzen, 2014)
(7) Innovation in my product line regularly adds new technological competences and leverages existing business models (Pisano, 2015)
(8) Innovation in my product line disrupts existing technological competences while conserving existing customer linkages (Abernathy & Clark, 1985)
(9) Innovation in my product line establishes a new dominant design through a new set of core components linked together in a new architecture (Clark & Henderson, 1990)
(10) Innovation in my product line provides radical technological breakthroughs to address the rapid evolution of technology in the market (Pisano, 2015)

Disruptive innovation

(11) Innovation in my product line is shifting the traditional value proposition to customers (e.g. from high performance to low cost) (Christensen, 1997)
(12) Innovation in my product line adds new business models and leverages existing technological competences (Pisano, 2015)
(13) Innovation in my product line leverages existing technology while creating new market opportunities (Abernathy & Clark, 1985)
(14) Innovation in my product line reconfigures an established system to link together existing components in a new way (Clark & Henderson, 1990)
(15) Innovation in my product line has the potential to create new market segments or even new industries by applying existing technology in new business models (Abernathy & Clark, 1985)

Architectural innovation

(16) Innovation in my product line potentially creates new market segments or even new industries through changes in both technology as well as business models (Abernathy & Clark, 1985)
(17) Innovation in my product line introduces new business models combined with new technological competences (Pisano, 2015)
(18) Innovation in my product line obsoletes existing technological competence while creating new customer linkages (Abernathy & Clark, 1985)
(19) Innovation in my product line combines technological and business model disruptions (Pisano, 2015)
(20) Innovation in my product line tries to build or find a new market that is in favor of new disruptive technology (Christensen, 1997)

Business performance

Please evaluate your business performance over the past year relative to your major competitors, on the following scale:
1 = much worse than competitors, 2 = worse than competitors, 3 = equal to competitors,
4 = better than competitors, 5 = much better than competitors

Customer satisfaction

(1) Delivering value to your customers
(2) Delivering what your customers want
(3) Retaining valued customers

Market effectiveness

(4) Market share growth
(5) Growth in sales revenue
(6) Acquiring new customers
(7) Increasing sales to existing customers

Profitability

(8) Business unit profitability
(9) Return on investment (ROI)
(10) Return on sales (ROS)
(11) Reaching financial goals

Commoditization level

To what extent do you agree with the following statements? 1 = fully disagree, 2 = somewhat disagree, 3 = neutral, 4 = somewhat agree, 5 = fully agree

Product homogeneity

(1) In my market, most products have no intrinsic differences from competing offerings
(2) In my market, product offerings are highly standardized
(3) In my market, homogeneity of technology and markets is high
(4) In my market, many products are identical in quality and performance

Price sensitivity

(5) In my market, customers check prices even for low-value products
(6) In my market, customers buy the lowest-priced products that will suit their needs
(7) In my market, customers rely heavily on price when it comes to choosing a product
(8) In my market, only pricing determines the competitive positioning of a products

Switching cost

(9) In my market, customers' costs in switching to another supplier are low
(10) In my market, applying another supplier's product would be easy for the customer
(11) In my market, the process of switching to a new supplier is quick and easy for the customer
(12) In my market, switching to a new supplier does not bear risk for the customer

Market stability

(13) In my market, there are no frequent changes in customer preferences
(14) In my market, there are no frequent changes in the product mix of suppliers
(15) In my market, technology changes are slow and predictable
(16) In my market, product obsolescence is slow