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How does the level of experience with disruptive innovation affect firms adoption rates of disruptive technologies and change of quality of their products?

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Abstract

This research contributes to the existing academic literature by linking firmÂ´s adoption of new technologies to NPD performance in markets characterized by continuous disruptive innovation or technological discontinuity. Rather than focusing on disruptive innovations which originate inside an industry like most studies do (Anderson and Tushman, 1990; Cooper and Schendel, 1976; Christensen, 1997; Foster, 1986; Schumpeter, 1942; Sood and Tellis, 2005), this study shows the adoption behavior and NPD performance of firms when they are confronted with disruptive innovations originating from outside their industry. This study places the role of experience with previous disruptive technology central to understanding this link, and investigates it within the video game industry.

Link between Experience and Use of New Technologies. Firms with a lack of experience with external disruptive innovations may react on the emergence of these innovations inadequately, and may, for example, overestimate the extent of a disruptive innovation (overreaction effect) and as a consequence make wrong decisions regarding the allocation of firmsâ?? resources. This overreaction effect assumes that inexperienced firms adopt external disruptive technologies to a greater extent (and more quickly) than experienced ones. In contrast, by surviving numerous market threats imposed by disruptive innovations and accumulating knowledge, experienced firms are able to better understand the advantages and drawbacks of exploiting prior technologies and adopting emerging ones. Hence, we assume that: Firms with a higher level of experience with external disruptive innovation use disruptive technologies in new products to a greater extent than firms with less experience.

Link between Experience, Adoption and Performance. Although in some cases the desire to conquer the market might lead inexperienced firms to adopt disruptive technologies more quickly, they might not manage to produce products of a higher quality with these technologies because of the lack of related experience. In contrast, thanks to their experience and knowledge of disruptive innovations, experienced firms can cope more effectively with each subsequent emergence of external disruptive innovations, and therefore extract more benefits from the same technology by producing products of high quality:

When firms adopt a disruptive technology, firms with a greater level of experience will more strongly increase the quality

of newly released products than firms with less experience.
This study collects firm (>1000 firms) and product data (>6,000 video games) from the video game industry. It investigates the video game developerâ??s adoption of disruptive technologies (i.e., DirectX version), and product quality (i.e., expert ratings). The video game industry provides an excellent opportunity to investigate the link between previous experience, adoption of new technologies, and business performance, as disruptive technologies are frequently introduced to this industry.
Although the regression results are not shown yet, this study will perform them quickly. We consider the use of before-after estimators (estimation of the differences in the average product quality before and after emergence of external disruptive innovation for the total sample as well as across different groups of companies defined on the basis of their experience with disruptive innovation) and a linear panel model (for the rate of adoption of new technologies as a dependent variable). At this stage, the sample size is 1091 video game developers (6160 unique products). Each company will be observed from the day of foundation until the day of defection or, if survived, until the present time. This structure of the data enables us to follow the development of companies over time, documenting their innovation activities and performance through a series of disruptive events. The study provides insights into how firms learn and develop dynamic capabilities when confronted with disruptive events.

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How does the level of experience with the emergence of external disruptive technologies affect firms' adoption rates of disruptive technologies and the quality of their products?

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Abstract: This study analyzes how firms' experience with disruptive technologies influences their new product development (NPD) and performance (adoption rate of disruptive technologies and the quality of products). The preliminary results show that the number of utilized disruptive technologies in the past does not affect the quality of currently produced products. However, the more products firms produce with the same technology, the higher the quality of products becomes.

Keywords: Disruptive technologies; disruptive innovation; external industries; products' quality; firms' experience; video game industry

1 Introduction

Any firm from any industry, that tries to outperform its competitors, introduces new services or products. The desire of firms to innovate is dictated, inter alia, by threats and/or opportunities induced by the emergence of disruptive technologies (Muller and Tilton, 1969; Taylor and Taylor, 2012), which replace the existing ones (Anderson and Tushman, 1990; Christensen, 1997). A vivid example of the emergence of disruptive technologies is the replacement of mobile phones by smartphones. The release of smartphones has reshaped the entire mobile phone industry. Former market leaders, such as Nokia, Motorola, Siemens, Sony Ericsson and Alcatel, were toppled by Apple, HTC and Samsung.

Scholars have tried to explain why and when disruptive technologies emerge (Cooper and Schendel, 1976; Schumpeter, 1942); what evolutionary stages technologies (products) go through before they turn into a disruptive one (Anderson and Tushman, 1990; Foster, 1986); what type of firms (small or big firms, incumbents or newcomers) introduce disruptive technologies (Chandy and Tellis, 2000; Dolfsma and Velde, 2014; Sood and Tellis, 2005); whether disruptive technologies are product only of radically new technologies or also of recombined existing ones (Christensen, 1997; Govindarajan and Kopalle, 2006). Albeit there is an extensive academic literature on the performance of firms under conditions when disruptive technologies emerge inside the industry, little is known on how firms react on the emergence of external disruptive technologies. Such a phenomenon takes place when changes that occur in one industry have spillover effects on other industries. The Internet is a well-known example of disruptive technologies that

have caused a disruption in many industries, such as, for example, music, video game, book publishing and film industries. The technology underlying the Internet was initially developed for the US military industry and eventually adapted for commercial use in other industries.

Firms may encounter the emergence of disruptive technologies repetitively (Hanvanich et al., 2006; Wilden and Gudergan, 2014), and by surviving these events they become more experienced and knowledgeable. This, in turn, might increase their ability to react effectively on the emergence of disruptive technologies in the future (George, 2005).

Academic literature has not yet provided a clear answer on the question how firms react on the emergence of external disruptive technologies and how the adoption of disruptive technologies and knowledge acquired from previous experience may impact the quality of their newly developed products. This study will address this gap in the literature by analyzing how the product development activities and quality of products change, when firms are confronted with a series of disruptive technologies which originate from outside a focal industry.

The study is performed on the example of video game industry. This highly innovative industry is comprised of two inter-related sub-industries: "software" and "hardware". The "software" sub-industry, which hosts the game developers and publishers of video games, is frequently confronted and strongly affected by the emergence of external disruptive technologies (e.g. new platforms, new platform features, new technologies enhancing graphics, audio, and speed of data processing) originating from the "hardware" sub-industry.

2 Literature review

Disruptive technologies

Two theoretical domains try to explain the emergence of new technologies, the nature of market disruptions, and the role of firms in these processes. The first domain is based on technology/product innovation life cycle theory (Anderson and Tushman, 1990; Foster, 1986; Lambe and Spekman, 1997) whereas the second one is based on theory of disruptive innovation (Christensen 1997).

The theory of technology/product innovation life cycle describes the life-cycle of technologies and explains when one specific technology used within an industry is substituted for another (Anderson and Tushman, 1990; Foster, 1986; Hamilton and Singh, 1992; Schumpeter, 1942; Taylor and Taylor, 2012). According to this theory, the emergence of novel technologies causes the emergence of new products that differ from their predecessors. It suggests that novel technologies cause a discontinuous effect or market disruption, that is, the moment when all supporters of the prior technology have to adopt the novel technology or perish (Anderson and Tushman, 1990; Foster, 1986; Klepper and Simons, 2005). Novel technologies cause a discontinuous effect and are often called revolutionary, discontinuous, disruptive, breakthrough, radical, emergent or step functioning (Florida and Kenney, 1990; Morone, 1993; Utterback, 1996; Yu and Hang, 2010).

Christensen (1997) developed another theory (theory of disruptive innovation) providing further insights to our understanding of disruptive technologies and market disruption. Contrary to technology/product innovation life cycle theory, which explains the disruptiveness solely from the position when prior technologies are toppled by radically new superior ones, the theory of Christensen (1997) argues that the disruption can be caused by technologies which are initially inferior to the mainstream ones, but later supersede existent technologies because of faster developments in the new feature

that is introduced. A vivid example is the introduction of the MP3 technology in the music industry which has disrupted the Audio-CD technology that was dominating in the 1990s. The MP3 technology initially was inferior to the Audio-CD technology in terms of the sound quality but was significantly better in terms of storage size, which allowed major benefits for mobile devices and data streaming. As a result of the quick development, the sound quality of the MP3 technology gradually reached the level of the Audio-CD technology which led to the displacement of the Audio-CD technology from the market. Christensen calls such technologies as "disruptive technologies" (Bower and Christensen, 1995) or "disruptive innovation" (Christensen, 1997).

The role of experience in product quality

There are different studies that analyze the role of firms' experience. A number of them analyze how firms experience influences products' quality. These studies identify the main factors that affect a change in products' quality, such as the complexity of the product, job tasks complexity, team experience in a certain domain, and communication between production team members. These factors are considered to be the most influential, especially in software industry (Otero et al., 2012). Otero et al. (2012) consider the level of firms' experience from the perspectives of firms' age, period of time that firms have spent exploiting a certain technology and the experience of personnel. In software industry, experience of personnel means the number of programming languages which have been mastered by employees and the time that has been spent by employees working with a certain product or technology. Otero et al. (2012) find that the number of mastered programming languages does not have any influence on products' quality. On the other hand, the experience of developing a certain product or participation in a certain project during a long period of time has positively significant interrelationships with the quality of products. These findings imply that variation of activities in the past (development of different products, mastering of different technologies) does not cause significant influence on the product quality whereas the extensive experience with one certain product / project may enhance product quality in the future.

A positive change in product quality is an outcome of successfully implemented technology and market strategies. Product quality may serve as an indicator of firm's performance. In the case of experiencing a sequential emergence of disruptive technologies, firms need to adjust their activities (strategies) in a way which allows them not only to survive on the market but also to increase their performance or product's quality. In other words, firms need to change frequently in order to perform well (Burgelman and Grove, 2007). The regularity of firms' changes, however, might depend on the frequency with which disruptive technologies emerge. Klarner and Raisch (2013) find evidence that the rhythm of technological changes plays a crucial role in the change of firms' performance. Those firms which experience technological changes with a regular pace perform better than those firms which experience them irregularly. These results imply that the number of technological changes or the number of developed projects in the past play less important role than the regular pace of changes. If firms operate in the environment where external changes take place frequently but irregularly, they might be less willing to adapt for these irregular external changes (Klarner and Raisch, 2013).

However, Garud and Nayyar, (1994) find that the more experienced firms are with a variety of prior technologies, the easier for them it is to master new technologies. This implies that they may perform more effectively and develop products of a higher quality than firms without such experience. In addition, the change of technologies with a regular

rhythm will not bring positive changes in products quality when technologies become obsolete very fast (Marsh and Stock, 2006).

All these findings force us to consider experience from two perspectives capturing its broadness and depth. The broadness of experience reflects the number of mastered technologies or variety of developed products in the past while the depth of experience reflects the extent (the amount of time) to which firms exploit one certain technology. Hence, both the broadness and depth of experience may affect product quality but under different circumstances. In addition, the magnitude of change (disruptive technology) may moderate the effect of experience. Klarner and Raisch (2013) find that a high magnitude of change negatively impacts firms' performance. This means that the role of accumulated experience becomes insignificant when firms face an external change with a high magnitude. However, Kuwada (1998) claims that firms which experienced the sequence of changes with a high magnitude in the past will eagerly support the emergence of new disruptive technologies that cause such changes.

3 Research question and conceptual model

Based on the arguments postulated above, this study aims to answer the following question:

How does the level of experience with the emergence of external disruptive technologies affect firms' adoption rates of disruptive technologies and the quality of their products?

The increasing number of disruptive technologies encountered by firms affects firms' surviving capabilities (George, 2005). Those firms that have encountered the emergence of several disruptive technologies gain experience and better cope with uncertainties than the firms without such experience (Bode et al., 2011; Greve, 1998; Yu and Hang, 2010). In contrast, firms with a lack of experience may react on the emergence of disruptive technologies inadequately (Bode et al., 2011), and may, for example, overestimate the extent of this event (overreaction effect) and as a consequence make wrong decisions regarding the allocation of firms' resources (Bode et al., 2011). This overreaction effect assumes that inexperienced firms adopt disruptive technologies to a greater extent than experienced ones. In contrast, by surviving the sequential emergence of disruptive technologies and accumulating knowledge, experienced firms are able to better understand the advantages and drawbacks of exploiting prior technologies and adopting emerging ones (Lefebvre et al., 1991). Hence, we assume that:

Hypothesis 1: Firms with a higher level of experience with prior disruptive technologies will use emerging disruptive technologies in new products to a greater extent than firms with less experience

Although in some cases the desire to conquer the market might lead inexperienced firms to adopt disruptive technologies more quickly (Danneels, 2004), they might not manage to produce products of a higher quality with these technologies because of the lack of related experience**.** In contrast, thanks to their experience and knowledge of disruptive technologies, experienced firms can cope more effectively with each subsequent emergence of disruptive technologies (Bode et al., 2011; Greve, 1998; Yu and Hang, 2010), and therefore extract more benefits from the same technology by producing products of high quality:

Hypothesis 2: *After the emergence of a disruptive technology, firms with a greater level of experience will increase the quality of newly released products to a larger extent than firms with less experience*

Finally, the degree to which firms can benefit from their accumulated experience and knowledge depends on the radicalness of the subsequent disruptive technologies (Helfat and Lieberman, 2002). The radicalness of the disruptive technology – similarly to product innovations – varies within industries. A comparison of DirectX[1] software versions shows that there are huge differences between DirectX 9 and 10, but not so much between DirectX 2 and 3. By experiencing the emergence of disruptive technologies of different radicalness, experienced firms may benefit from their accumulated experience to develop a strategy that allows them to effectively cope with disruptive technologies with various nature of radicalness (Helfat and Lieberman, 2002). However, when a disruptive technology with the highest level of radicalness occurs and this technology is completely different from all previous technologies, experienced firms are expected not to benefit strongly from their experience as it has little value in capitalizing on the radically new disruptive technology (Danneels, 2004, Helfat and Lieberman, 2002). Also, successful survivorship of the emergence of disruptive technologies with the same low to medium level of radicalness may put firms into inertia and make them to underestimate the consequences of the emergence of disruptive technologies with the highest level of radicalness (Burgelman and Grove, 2007). In such a case, the accumulated knowledge will have little use and might play against experienced firms. Hence, we hypothesize that:

Hypothesis 3 The positive relationship between firms' level of experience and improvement of product quality will be weaker when disruptive technologies has the highest level of radicalness

The conceptual model employed in the paper is presented in Figure 1.

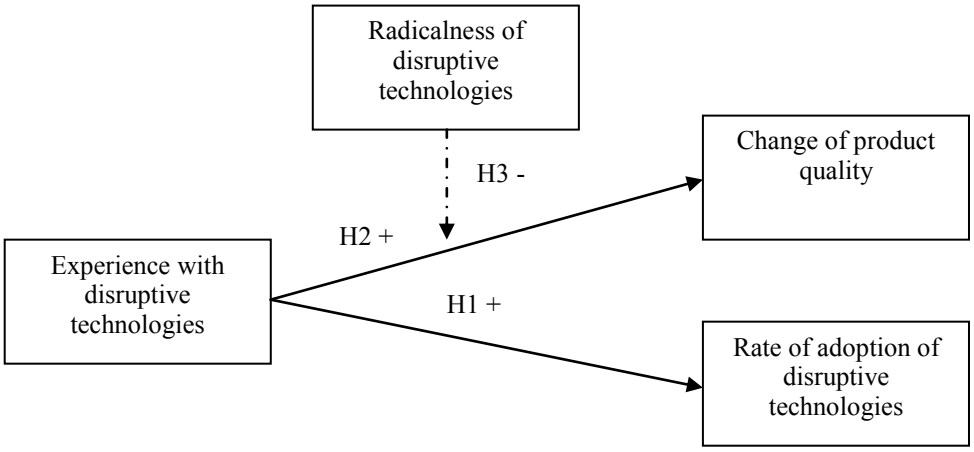

Figure 1 Conceptual model.

[1] DirectX is a free software program that helps developers to program games that can run on Microsoft platforms with the help of application programming interfaces (APIs).

3 Research design

This study is performed on the example of video game industry. The video game industry can be split in two main sub-industries - "hardware" and "software". While the hardware sub-industry is represented by several firms, software sub-industry is represented by thousands of firms. It implies that the majority of firms do not produce "hardware" components but solely "software" ones (video games). The fact that "software" developers do not put any R&D efforts on hardware development allows us to consider both parts of the industry (software and hardware) as independent domains. This implies that all changes in technologies which take place within the "hardware" sub-industry may potentially cause disruption in the "software" sub-industry. Thus, in this paper the "software" sub-industry is taken as a focal industry and "hardware" sub-industry as an external industry.

In addition, disruptive technologies frequently emerge in video game industry. All changes that take place in the "hardware" sub-industry (potentially disruptive for the "software" industry) can be associated with the emergence of new video game consoles, or emergence of a new generation of hardware components of computers (micro-processors, graphic cards, random access memory technologies, and others). Given that such changes are regularly taking place in the "hardware" sub-industry, "software developers" operate under the condition of permanently changing environment.

To sum up, "software" sub-industry reflects the environment where firms are affected by external disruptive technologies which are introduced frequently, and vary in level of radicalness.

Data collection

The study is based on secondary data collected and merged from independent sources of information, namely "Game Spot" division of the CBS Corporation (www.cbscorporation.com); "Metacritic" (www.metacritic.com); VGChartz (www.vgchartz.com); Game Rankings (www.gamerankings.com); and Microsoft Corporation (www.microsoft.com). The data contain information on: 1) firms' experience with disruptive technologies; 2) radicalness of disruptive technologies; 3) change of product quality; 4) rate of adoption of disruptive technologies.

The variables are operationalized in the following way:

Dependent variable 1: 'Change of product quality'. The main indicator of the quality of video games is their ranking which is based on the assessment of players and industries' experts. There are different web-resources that provide information about such ranks. However, there are at least two objective web-resources that provide aggregated ranks for video games, namely Metacritic and Game Rankins. At this stage of the study we have used Game Rankins dataset since it covers a broader (in terms of the age) range of products. In order to operationalize the change in product quality, we took the difference in ranks of each generation of products for the same firm. Thus, the acquired value reflects how the quality of a given product has changed compared to its predecessor.

Dependent variable 2: 'Rate of adoption of disruptive technologies'. In order to operationalize this variable we have measured the ratio of products based on a disruptive technology to products based on the prior technology for each firm. The ratio is calculated between the emergences of two disruptive technologies. At this stage of the research, we used each generation of DirectX software toolkits as an indicator of the emergence of a disruptive technology.

Independent variable: 'Experience with disruptive technologies'. The experience with disruptive technologies is measured in two ways. First, we measure the broadness of experience by calculating how many generations of disruptive technologies (versions of

DirectX) the firm has used before the release of current products. Second, we measure the depth of experience by approximating accumulated experience that the firm has acquired through the release of a series of products based on the same disruptive technology. We calculate it as a number of video games produced on the same version of DirectX as the current product.

Moderating variable: 'Radicalness of disruptive technologies'. This variable is to capture whether emerging technologies (potentially disruptive) were radical or incremental. In the study we consider the main iterations of DirectX as radical changes and auxiliary iterations as incremental changes.

Secondary data cover the whole population of firms (around 8500 units [Game Spot division of CBS Corporation (www.cbscorporation.com)]) and the whole range of products (video games) (more than 70 000 of units) for four main platforms (Xbox; PlayStation; Nintendo; PC) for the timeline from 1994 to 2014. After merging the data from Game Rankings and VGchartz and operationalizing the variables we obtained 5376 observations in total. However, there were only 1874 observations of DV with non-missing values which we could use for the analysis. In addition, to increase the reliability of the results, we excluded observations where video game ranks were based on fewer than 5 reviews. With this selection, the sample size decreased to 1155 observations.

The analysis is performed with ordinary list squares regression technique separately for both samples (1874 and 1155 observations), and with two different specifications of the independent variable (IV).

4 Findings

At this stage we have preliminary estimation results for the relationship between the 'experience with disruptive technologies' and the 'change in product quality'. All estimations are performed controlling for the clustering of observations within the firms.

The analysis for the full sample (1874 observations) has shown that the broadness of experience does not pose any significant influence on the quality of products (the estimated coefficient for the IV variable is 0.014 with the p-value equal to 0.944). At the same time, the depth of the experience with disruptive events does affect the quality of the produced products (the coefficient for the IV variable is 0.285 with the p-value of 0.012).

The analysis of the restricted sample (with 1155 observations) has also yielded insignificant influence of the broadness of the experience (β=0.119 and p-value= 0.452). However, both the effect size and significance level of the depth of experience have substantially increased – the β-coefficient almost doubled constituting 0.441 points and the p-value dropped below the critical value of 0.000). These results suggest that one additional product manufactured on the same version of DirectX before increases the ranking of the current product by 0.441 points.

It is important to mention that this is only preliminary results. We did not control for firms' age, geographical location, size etc. We did not take into account the time period when products were ranked and the radicalness of each iteration of DirectX.

However, from these results we can assume that the number of the utilized disruptive technologies in the past doesn't cause any effect on the quality of released products. In contrast, when firms use the same technology continuously, each new product based on the same technology will be of a higher quality than its predecessor. This finding implies that each generation of disruptive technologies disrupts competencies of firms and all experienced and inexperienced firms have the same chances to deliver a new successful product on the market.

5 Contribution

This research will contribute to the existing academic literature focusing on the behavior and NPD performance of firms which are repeatedly confronted with disruptive technologies or technological shifts. Rather than focusing on disruptive technologies which originate inside the industry, like most studies do, it will yield evidence on the behavior and NPD performance of firms when disruptive technologies originate from outside the industry. The results will provide insights on the influence of experience with disruptive technologies on the rate of adoption of disruptive technologies and on the change of product quality.

6 Practical implications

The study will be interesting for those practitioners who operate in industries where technological changes occur frequently and who face a dilemma whether to invest resources and efforts in exploiting one certain technology or disperse them for other technologies. It also shows the influence of experience that firms gain via surviving sequential emergence of technologies, experience that firms gain exploiting different generations of disruptive technologies or experience gained by intensive exploitation of one specific technology on the quality of products.

9 Reference List

Anderson, P., Tushman, M., 1990. Technological Discontinuities and Dominant Designs: A Cyclical Model of Technological Change. Administrative Science Quarterly 35, 604-633.

Bode, C., Wagner, S.M., Petersen, K.J., Ellram, L.M., 2011. Understanding Responses to Supply Chain Disruptions: Insights from Information Processing and Resource Dependence Perspectives". Academy of Management Journal 54(4), 833-856.

Burgelman, R.A., Grove, A.S., 2007. Let chaos reign, then rein in chaos – repeatedly: Managing strategic dynamics for corporate longevity. Strategic Management Journal 28, 965-979.

Chandy, R.K., Tellis, G.J. 2000. The Incumbent's Curse? Incumbency, Size and Radical Product Innovation". Journal of Marketing 64(3), 1-17.

Christensen, C.M., 1997. The innovators' Dilemma: When New Technologies Cause Great Firms to Fail. Boston, MA Harvard Business School Press.

Cooper, A.C., Schendel, D., 1976. Strategic Responses to Technological Threats. Business Horizons 19(1), 61-69.

Danneels, E., 2004. Disruptive Technology Reconsidered: A Critique and Research Agenda. The Journal of Product Innovation Management 21, 246-258.

Dolfsma, W., van der Velde, G, 2014. Industry innovativeness, firm size, and entrepreneurship: Schumpeter mark III?. Journal of Evolutionary Economics 24(4), 713-736.

Florida, R., Kenney, M., 1990. The Break through Illusion. New York. Basic.

Foster, R., 1986. Working the S-curve. Assessing Technological Threats. Research Management 7(8), 17-22.

Garud, R., Nayyar, P.R., 1994. Transformative capacity: Continual structuring by intertemporal technology transfer. Strategic Management Journal 15, 365–385.

George, G., 2005. Learning to be capable: patenting and Licensing at the Wisconsin alumni research foundation 1925-2002. Industrial and Corporate Change 14, 119-151.

Govindarajan, V., Kopalle, P.K., 2006. The usefulness of measuring disruptiveness of innovations ex post in making ex ante predictions. Journal of Product Innovation Management 23, 12-18.

Greve, H.R., 1998. Performance, aspirations, and risky organizational change. Administrative Science Quarterly 43, 58-86.
Hanvanich, S., Sivakumar, K., Hult, G.T.M., 2006. The relationship of learning and memory with organizational performance: the moderating role of turbulence. Journal of the Academy of Marketing Science 34, 600-612.
Hamilton, W., Singh, H., 1992. The evolution of corporate capabilities in emerging technologies. Interfaces 22(4), 13-23.
Helfat, C. E., Lieberman, M. B., 2002. The birth of capabilities: market entry and the importance of pre-history. Industrial and Corporate Change 11(4), 725-60.
Klarner, P., Raisch, S., 2013. Move to the Beat – Rhythms of Change and Firm Performance. Academy of Management Journal 56 (1), 160-184.
Klepper, S., Simons, K., 2005. Industry shakeouts and technological change. International Journal of Industrial Organization 23, 23-43.
Kuwada, K., 1998. Strategic learning: The continuous side of discontinuous strategic change. Organization Science 9, 719-736.
Lambe, J., Spekman, R., 1997. Alliances, external technology acquisition, and discontinuous technological change. Journal of Product Innovation Management 14, 102-116.
Lefebvre, L. A., Harvey, J., 1991. Technological experience and the technology adoption decisions in small manufacturing firms. R&D Management 21(3), 241-249.
Marsh, S.J., Stock, G N., 2006. Creating dynamic capability: The role of intertemporal integration, knowledge retention, and interpretation. Journal of Product Innovation Management 23, 422–436.
Morone, J. 1993. Winning in High Tech Markets. Boston, MA: Harvard Business School Press.
Muller, D., Tilton, J., 1969. Research and development costs as a barrier to entry. Canadian Journal of Economics 2(4), 570-579.
Otero, L. D., Centeno, G., Otero, C.E., Reeves, K., 2012. A DEA – Tobit Analysis to Understand the Role of Experience and Task Factors in the Efficiency of Software Engineers. IEEE Transactions on Engineering Management 59 (3), 391-400.
Schumpeter, J., 1942. Capitalism, Socialism and Democracy. New York: Harper.
Sood, A., Tellis, G.J., 2005. Technological evolution and radical innovation. Journal of Marketing 69(3), 152-168.
Taylor, M., Taylor, A., 2012. The technology life cycle: Conceptualization and managerial implications. International Journal of Production Economics 140, 541-553.
Utterback, J., 1996. Mastering the Dynamics of Innovation. Harvard Business School Press. 259.
Wilden, R., Gudergan, S.P., 2014. The impact of dynamic capabilities on operational marketing and technological capabilities: investigating the role of environmental turbulence. Journal of the Academy of Marketing Science, 1-19.
Yu, D., Hang, C., 2010. A reflective review of disruptive innovation theory. International Journal of Management Reviews 12(4), 435-452.