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UNFOLDING NEW HORIZONS: PREDICTIVE ANALYTICS AS A FACILITATOR OF OPEN INNOVATION

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Abstract:
In the era when Big Data and Business Intelligence spark their application in different industries, we strive to illuminate the potential of data usage for enhancing innovation processes for companies operating in B-to-C context. Thus, this article builds a foundation for understanding how Predictive analytics (PA) can promote customer involvement in the fuzzy front end of open innovations. PA as a technology originates from IT industries where its application dominates. Very little is said about its potential for consumer goods industries. Yet, since PA helps to process data in a structured way and provide a specific insight, we assume that consumer goods companies can predict the future behavioural trends, by applying PA to analyse customer behaviour. This could be a significant contributor to envisioning new markets and industrial foresight. Given the increasing role of network interaction, not only customers but also other network participants can contribute and catalyse innovation processes, in this setting known as open innovation. It is predominantly possible due to interaction on online platforms - an architect of such networks. This paper outlines the potential of PA for facilitating customer involvement at the fuzzy front end of open innovation and offers conceptual basis for the subsequent empirical study of this issue by developing specific hypotheses which are to be tested. We infer that PA when properly applied has a tremendous potential in driving innovations in the companies by organising data and providing a meaningful insight into customer behaviour.

Keywords: predictive analytics, open innovation, networks, B-to-C, customer involvement

1. INTRODUCTION

Companies, willing to survive under market uncertainty and volatility, need to be able to constantly renew and to innovate (Schumpeter, 1934; Jacobides et al., 2006). Innovation went through a set of changes triggered by the market needs based on the changing role of customers (von Hippel, 1976; 1978), introducing an emerging trend - 'user-centered innovation system' - which appears as a substitute to the 'manufacturer-based innovation system' (von Hippel, 2005). Further, the increasing role of networks interaction and shrinking ability of companies to tackle the complexity of the market, triggered companies to integrate into innovation processes ideas of external market players (Foss, Laursen, & Pedersen, 2011), determining the nature of innovation processes as open innovation (Chesbrough & Crowther, 2006). Indeed, for the innovation processes companies can utilize both internal and external ideas, in particular for the (fuzzy) front end innovation processes (Kim & Wilemon, 2002). Customers become more and more knowledgeable about the products due to the technological development - they have an opportunity to obtain, compare and discuss information about the product with other customers. Besides, they as product consumers understand the value they receive from the product and subconsciously store knowledge of how the product should look like. Yet, articulation of the knowledge is extremely challenging, in particular, when we deal with B-to-C context.

The development of internet opens up new possibilities for customer integration on a more practical level. Much is said about integration of customers through social media applications and development of virtual communities (Wu & Fang, 2010, Füller & Matzler, 2007, Sawhney, Verona, & Prandelli, 2005). However, more solid and specific information for specific product development - as practice indicates - could be achieved through customer integration on online design platforms. However, such a practice requires a sufficient the IT support to deal with a constantly increasing data pool, generating Big Data (Koen et al., 2001).

Big Data and such related concepts as *Business intelligence* or *Business analytics* are new buzzwords, which emerged as a result of technological development, predominantly in IT sector, and seep into business (Bughin, Chui, & Manyika, 2013). The need for creating the knowledge for different purposes within and across the organisations triggers escalation of data usage. Data per se does not contribute in any sense. Data needs to be systematically processed which caused the development of a specific infrastructure, tools and techniques for efficient data and knowledge management (Chase, JR., 2014) and conversion of data into meaningful insights (Chen, Chiang, & Storey, 2012). Business analytics is a technology that assists data processing and helps sustaining competitive advantage. Moving further in its development process, a new generation of business analytics, so called advanced or predictive business analytics besides just data systemization offers prediction of specific trends based on input information.

Given the peculiarities of customer involvement at the fuzzy front end of open innovation and need for sufficient technologies to tackle the emerging complexity, we strive to evaluate the value of predictive analytics in facilitating those processes. It is obvious that open innovation would derive from its pure fashion in different business context, depending on the type of industry and company. By now, research on the application of open innovation dominates in IT industries where pure fashion of open innovation is observable. However, how in B-to-C manufacturing companies, striving for open idea generation, this process might significantly differ, yet it does not impede those companies to innovate and sustain their competitive advantage.

Research question:
How can predictive analytics (PA) facilitate customer involvement at the fuzzy front end of open innovation in B-to-C context?

2. FUZZY FRONT END OF OPEN INNOVATION

Meanwhile, internationalization, technology, in particular internet development, and the increasing role of networks prepared the foundation for a shift towards open innovation (Chesbrough & Crowther, 2006; Lee et al. 2010). It implies a shift from controlled in-house innovation processes towards commercializing external ideas and is defined as "[...] a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to the market, as they look to advance their technology" (Chesbrough et al., 2006, p.2). Under these circumstances, not only customers but other network participants can contribute to the product development as every business actor possess specific information of how to improve innovative idea.

The main prerequisites of open innovation are network interactions and establishment of network relationships between business actors (Dittrich & Duysters, 2007). Indeed, in certain industries and sectors, in particular high-tech and IT, the dominant role of network interaction superseded customer-supplier interaction. An increasing role of the information exchange and knowledge creation requires a new hybrid form of governance (Williamson, 1985) of such a structure. The challenge is determined by high flexibility networks and constant changes of their participants.

Research in this area was predominantly explicating open innovation in high-tech industries (Chesbrough & Crowther, 2006; van de Vrande, Jong, Vanhaverbeke, & Rochemont, 2009; West & Gallagher, 2006) since this type of innovation emerges in this domain, as determined by the industry needs. However, given the definition of open innovation, we broaden application of the process of generating and leveraging external ideas to other industries and business settings. One of the interesting findings in this vein are presented by Chiaroni, Chiesa, & Frattini (2011) who identified the peculiarities of implementation of open innovation in mature industries, highlighting the role of organisational structure and networks of firms. It supports our assumption of the emergence of open innovation in other industries.

Customer involvement into innovation process is a complex issue, and in different cases interaction is enabled and possible to a different extent. The concept of "fuzzy front end" (FFE) implies the starting point of the innovation process (Khurana & Rosenthal, 1998). Koen et al. (2001) developed a unified model which describes the crucial factors for the FFE which are idea genesis, idea selection, opportunity identification, opportunity analysis and concept development. In fact, these factors are a blend of "need" information possessed by customers and "know-how" information which resides at the manufacturer side. This paper focuses on the customer side, namely customer involvement into FFE of open innovation which leads to identification of new markets. Further, in B-to-C context, companies struggle to involve customers in a systematic way or identify lead users, which would ensure envisioning of new markets. Academia does not offer any coherent practices of how to deal with open innovation in such settings. Logically deduced, that peculiarities of B-to-C settings would require a specific approach for dealing with networks, generating, processing and utilising all kinds of information. Yet, practice suggests that open innovation takes place in such constellations when coupled with technological development. Such processes are enabled by design networks (Accenture, 2008) - online platforms which give the customer possibilities to innovate the products. The Internet enabled interaction of companies and customer at a different level (Prahalad & Ramaswamy, 2004). Yet, "need information" is rather "sticky" and reside at the customer side (Thomke and von Hippel, 2002) and customers often fail to articulate it in a way which can be a sufficient input for companies. Therefore, managing customer involvement at the FFE requires appropriate IT support to manage data which reflect customer behaviour.

3. PREDCTIVE ANALYTICS: OPPORTUNITIES FOR BUSINESS

Business reality, shaped by Big Data and its applications trends, is creating a specific environment where companies are to compete and sustain their competitive advantage (Bell, 2013; Bose, 2009). Companies which do not learn how to compete on it, are exposed to a big threat to their survival. The amount of data is annually drastically increasing, as indicate reports on the related issues (McKinsey&Company, 2011). Ignorance of those trends is dangerous for the companies. Those who have learned to leverage advantages of data increase their chances to outperform competitors as they base their business process-related decisions on real and up-to-date information (Davenport, 2006). Dwelling on this, these companies benefit in terms of dominant knowledge about their customer needs, market trends, operational costs and supply chain as the role of coherent data management techniques. Those factors are crucial for carrying the supply chain to a new quality level (Davenport & Harris, 2007; Trkman, McCormack, Oliveira, & Ladeira, 2010; Waller & Fawcett, 2013). Complexity of Big Data in business is tackled by a variety of applications, where business analytics plays a crucial role as it has a potential to sustain firm's competitive advantage (Sharma et al., 2010). Business analytics is defined as "[...] an integration of disparate data sources from inside and outside the enterprise that are required to answer and act on forward-looking business questions tied to key business objectives" (Isson & Harriott, 2013, p. 3).

Talking implications of business analytics for the business in general, they can be classified as (1) descriptive, (2) prescriptive, and (3) predictive (Davenport, 2006; LaValle, Hopkins, Lesser, Shockley, & Kruschwitz, 2010). The difference between these three lies in the data application for specific purposes. Conventional models of analytics - which only process historic data generating findings on what has happened - are known and widely used for a long time already, and are primarily descriptive. Building upon its limitations, the barriers are pushed towards answering the question *"why some specific event happen and what can we learn from it?"*. This builds the foundation for a new type of analytics, namely *predictive analytics (PA)*. (Siegel, 2013, p. 11) defines predictive analytics as a "[...] technology that learns from experience (data) to predict the future behaviour of individuals in order to drive better decisions".

Striving to gain more insights from the data, companies move towards implementation of predictive analytics. Compared to descriptive analytics, predictive facilitate answering completely different questions, oriented on the future-related solutions. Corporate foresight was already outlined as a prerequisite for sustaining competitive advantage through innovating and envisioning new market trends (Hamel & Prahalad, 1991). Yet, in this manner -under a pressure of considerable rapid technological changes and market volatility - corporate foresight is exposed to high complexity. To create a new market by offering a novel specific product and/or service, companies should have a reference point, namely the information which would serve as a foundation for envisioning new markets, since relying on gut decisions is an unjustified risk. It increases the need for technological solutions which would secure different kinds of decisions by providing data-based backup.

Predictive analytics already found its application in different industries and for improving specific organisational functions in the companies. Thus, Siegel (2013) emphasis advantages of PA for financial, marketing, HR sectors, and even healthcare, politics and crime fighting. Besides financial services, Srinivasan (2012) accumulated interesting findings of PA application in retail and manufacturing. Retailers are provided with a significant input about customer behaviour in different segments what facilitate customization of customer experience and rendering personalized services. In terms of manufacturing, PA was claimed to be a sufficient to evaluate what, how and how much to produce. In this vein, PA sparks significant contribution to supply chain optimization.

Advantages of PA are usually argued on a generalized to decision-making processes in all the corporate areas. Scrutiny indicated that less if anything was said about utilization of PA for innovative purposes. Thus, we wonder whether PA, by leveraging a proper data from the data pool, could be a sufficient tool for facilitative open innovation.

4. METHODOLOGY

This study aims to build first understanding of how manufacturing companies in B-to-C context can manage customer involvement at the FFE of open innovation. Scrutiny indicated that such a context poses a significant impact on the peculiarity of open innovation; besides, market complexity generates a pool of data difficult to deal with. It drives a need for technological interference for process facilitation. While observing technological trends related to Big Data and its utilisation, we discovered that PA could potentially be a sufficient technique to process data on customer behaviour and generate meaningful insights which companies could use in R&D processes. Given the novelty of PA application for innovation processes, this paper offers a conceptual basis of PA potential in given context and strives to develop theoretical propositions which are to be empirically tested by other scholars.

The paper is limited to the analysis of FFE of open innovation, given the peculiarities of customer involvement combined with the need to process complex and dynamic sets of data. In the search for sufficient techniques, we assume PA has a potential to tackle this challenges. To develop and to conceptualize the role of PA for such aforementioned content, we draw on the literature of asset stock accumulation. It should be stressed that this paper takes into consideration exclusively business side of this issues, taking IT possibilities for granted.

5. ASSET STOCK ACCUMULATION: DEVELOPMENT OF RESEARCH PROPOSITIONS

In a broad sense, knowledge assets appear to be a fundamental source of company's competitive advantage (Bollinger & Smith, 2001). Yet, knowledge is rather vague and broad concept. In the context of innovation, knowledge-based assets are recognized as one of the most critical for the innovation processes in the company (Jantunen, 2005). Given the delimitation of this research, we focus on the knowledge retrieved from customers which can be utilized for open innovation.

To sustain competitive advantage by profiting from the open innovation process, Dierickx & Cool (1989) claim that only accumulation of certain assets would ensure this process. Building upon Barney's theory of factor markets (Barney, 1986), the respective assets could be only accumulated, as many assets are non-tradable. Given this argumentation, assets are accumulated by coupling specific asset flows at any point of time.

Companies which recognize the need of customer involvement, strive to capture the information about customer behaviour at the front end of innovation. Yet it is not enough just to store the data; the ability to draw meaningful insights and using it as an input for innovation processes is the cornerstone for companies' competitiveness. Customer input is significant but difficult to deal with when it comes to B-to-C context which is determined by market scope (Hippel, 2005). Meanwhile, predictive analytics models give an opportunity to process and present for a managerial use a vast amount of different information such as online purchase patterns, customer conversion, product adoption etc (Isson & Harriott, 2013).

Contemporary settings highlight the dynamic perspective of asset stock accumulation, shedding a different light on asset flows. To accumulate the asset stock which would provide a foundation for competitive advantage, we have to assure the continuity and consistency of asset flows, especially when we talk about customer involvement at the innovation FFE.

PA which is assumed of being a facilitator of managing open innovation could have a potential to secure companies competitive advantage by contributing to asset stock accumulation. To specify PA contribution, we contrast it against characteristics of asset stocks developed by Dierickx & Cool (1989):

Time compression - in case of new idea generation, companies need to accumulate ideas from the market over the long period of time, observing their patterns and building specific market trends. Building market knowledge based on the constant observation of customer behaviour would generate companies' competitive advantage over the companies which conduct a single market research within a given period of time. Increasing role of time in current market conditions of fast major changes triggers specific embedded flexibilities of the companies to react fast to market changes at all the levels of corporate decisions (Sawhney et al., 2005). In case of product markets, the process requires a certain techniques which would tackle the data complexity, converting and presenting it in a comparable for. With that in mind, PA and its underlying characteristics could be one of the possibilities which would facilitate to build a coherent and solid understanding of the situation (Chen et al., 2012) and therefore, secure the possibility of imitation of a certain knowledge and understanding of the future market trends, and therefore sustaining competitive advantage.

Propositions 1: PA helps overcoming time compression diseconomies related to knowledge-based asset accumulation at the FFE of open innovation and thus, facilitates customer involvement.

Asset mass efficiencies - implies a positive aspect of a so-called "snowball effect" in the process of asset stock accumulation. In other words, the more assets the company accumulated, the easier it is to sustain further accumulation processes. Translating it into the knowledge as an asset, a company needs to constantly maintain a significant and structured level of awareness about the market. Knowledge-based asset stock accumulation is a dynamic process which in B-to-C context requires structural approach to avoid data extrapolation. Building a sustainable database which could be considered as a knowledge-based asset stock demands specific application. In the vein of previous debates on PA, we assume that this technology has a potential to facilitate stock accumulation in a way to maintain it unique nature and eliminate imitability by other firms which have an access to similar raw data as an input.

Proposition 2: PA maintains asset stock efficiencies related to knowledge-based asset accumulation at the FFE of open innovation and thus, promotes customer involvement.

Interconnectedness of asset stocks - brings the significance of dependencies of stock accumulation on the other stocks. In fact, in the context of open innovation require accumulation of the different knowledge-based stocks for sustaining R&D processes. Knowledge-based assets based on observation of customer behaviour depend on the organisation of the platform where customers have a possibility to act as an innovator. However, efficient platform architects do not ensure competitive advantage itself. Such platforms should have sufficient techniques for data processing and structuring (Fayyad, Piatetsky-Shapiro, & Smyth, 1996). Business analytics which is mostly embedded into the data processing have a possibility to deliver reports based on historical data (Davenport, 2006). Yet, PA adds more value as gives first knowledge-based input for innovation processes, e.g. emerging market trends.

Proposition 3: PA facilitates to process knowledge-based asset accumulation at the FFE of open innovation and thus, facilitates customer involvement.

Asset erosion - asset stocks having a tendency to depreciate. In fact, market knowledge-based assets have a very vague accumulation rate as customer behaviour change daily and causing information ambiguity. Trend recognition based on data become challenging unless is based on models able to grasp rapid environmental dynamics. PA, if predictive model is customized to embrace specific firm challenges and significant sources of data input, would maintain knowledge-based assets by updating and verifying asset stocks.

Proposition 4: PA eliminates knowledge-based asset erosion at the FFE of open innovation and thus, supports customer involvement.

Causal ambiguity - even similarity in asset stocks does not ensure the same outcomes for different firms. Indeed, having similar access to data on customer behaviour, firms can interpret this data differently what leads to differences in innovation processes. In any case, data interpretation process is dependent on technological application behind. PA as a new generation in business analytics techniques, gives a chance to envision future market trends and position the company ahead of its competitors by “winning time” for creating new niche/market.

Proposition 5: PA gives a chance to overcome causal ambiguity related to utilisation of knowledge-based assets at the FFE of open innovation and thus, facilitates customer involvement.

6. DISCUSSION

Open innovation is a very ambiguous concept when it comes to its implementation in B-to-C context. Companies operating in such industries as consumer goods, consumer electronics etc before all else face difficulties already when it comes to customer involvement, and what’s more challenging, identification of lead users which would present a leading edge of the market. Given this challenge, open innovation cannot take place in its pure fashion as the input information for the innovation processes cannot be, first, retriever and, second, utilized by other network participants for triggering innovation within the value network.

Highlighting the challenges for companies in B-to-C to manage customer involvement in FFE while opening innovation processes, we look for ways which would facilitate those processes. In this vein, predictive analytics and possibilities of underlying technologies have a potential to foster data management. Information stemming from customers has a tremendous significance for FFE of innovation processes (Kim & Wilemon, 2002) and is considered as an asset for the companies. These knowledge-based assets have their peculiarities and in order to maximize their value, need to be managed properly. The biggest challenge is rooted in efficient knowledge discovery in databases (Fayyad et al., 1996) preparing customer input into FFE of innovation processes.

Cross-functional application of predictive analytics (Siegel, 2013) and crucial role of building distinctive capabilities to compete on advanced analytics (Davenport & Harris, 2007) was already discussed in the literature. However, a certain advantage of PA utilisation for enhancing innovation processes is lacking the observation. With this paper we set a cornerstone for the research in this area and develop a first set of propositions which are to be empirically tested in the upcoming studies.

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