Business models for disruptive technologies - findings from the 3D printing industry

Summary

3D printing is a vibrant research topic in technical sciences and medicine. However, in entrepreneurship as well as innovation research the topic is nascent at best, despite the fact that the technology has high potential to be disruptive.

The aim of our study is to analyze currently used business models in the emerging 3D printing industry through publicly available secondary data. The data gathered form 290 firms is analyzed to identify already existing business model patterns. Thus current archetypes of business models in the 3D printing industry can be defined. Based on this analysis it can be concluded whether or not a dominant industry logic is already established or has yet to evolve. Identified firms are located in Northern America and Europe. The two continents were chosen because they are strong drivers of the 3D printing industry's evolution and are among the fastest evolving 3D printing markets.

Introduction

3D printing is a vibrant research topic in technical sciences and medicine. However, in entrepreneurship as well as innovation research the topic is nascent at best, despite the fact that the technology has high potential to be disruptive (McKinsey Global Institute, 2013). Disruptive technologies offer performances that are new to the respective market. Due to the disruptive technology's inferior performance of mainstream applications it initially serves niche markets. The successful introduction of a disruptive technology to the market fosters performance improvements (Christensen, 1997).

In the process of technology adoption business models are of pivotal importance for companies as they function as facilitators for technology commercialization (Chesbrough & Rosenbloom, 2002; Chesbrough, 2010; Holzmann, 2015). However, especially for companies

in emerging industries - like the 3D-printing industry - the development of a viable business model is challenging. As a result, companies often apply trial-and-error like approaches and experiment with different business models until they find an adequate business model (Teece, 2010).

As a business model per se is not a patentable invention (Teece, 2010), it can become the subject of imitation. Continuous imitation of viable business models by multiple competitors yields to the genesis of certain business model patterns. If in a given industry this patterns are further adjusted to one another a dominant industry logic regarding viable business models evolves (Sabatier, Craig-Kennard & Mangematin, 2012; Phall, O'Sullivan, Routley, Ford & Probert, 2011).

The aim of our study is to analyze currently used business models in the emerging 3D printing industry through publicly available secondary data as well as primary data. The data gathered form 290 firms is analyzed to identify already existing business model patterns. Thus current archetypes of business models in the 3D printing industry can be defined. Based on this analysis it can be concluded whether or not a dominant industry logic is already established or has yet to evolve. Identified firms are located in Northern America and Europe. The two continents were chosen because they are strong drivers of the 3D printing industry's evolution and are among the fastest evolving 3D printing markets (Wohlers Associates, 2014).

On the Nexus of Business Model and Technology

The business model concept has often been criticized for its vagueness (e.g. Magretta, 2002; George & Bock, 2011; Zott, Amit & Massa, 2011). However, despite all definitional ambiguity, there seems to be a growing consensus that a business model is comprised of

value proposition, value creation and value capture (e.g. Shafer et al., 2005; Johnson et al., 2008; Doganova & Eyquem-Renault, 2009).

The value proposition is a central component of the business model. It comprises of a respective company's bundle of products and services (Osterwalder et al, 2005) and therefore defines the derived benefits for the potential customer (Mason & Spring, 2011). The value creation component specifies processes, partners and channels required to honor the company's value proposition. Value capture encompasses revenue generation, cost structure and ultimately profits (Osterwalder et al., 2005; Johnson et al., 2008)

Business models are of pivotal importance for technology as they function as mediators linking technology and firm performance (Baden-Fuller & Haeflinger, 2013). That is, because a technology itself has no inherent value (Chesbrough, 2007). Especially in the context of disruptive technologies, a business model's purpose is to translate technical success into commercial success (Teece, 2010).

Disruptive technologies can potentially lead to technology shifts. The occurrence of such a shift often causes a business model dilemma for the respective company as it has to simultaneously cope with the technology as well as the challenge to develop an appropriate business model for its commercialization (Tongur & Engwall, 2014). Christensen (2006) claims that in this scenario the fundamental challenge is not the technology, but the business model.

Data and Methodology

Data collection took place from October 2014 till January 2015. 290 firms in the 3D printing industry in Europe and Northern America which feature the following criteria were identified by web search: (1) manufacture 3D printers, 3D printing material or 3D printing accessories or provide a 3D print or 3D print related service, (2) firms should not focus solely on B2B

markets and (3) enough information about the three business model components (value proposition, value creation and value capture) had to be available on the firm's website. In addition to the website information was gathered through company profiles (e.g. chamber of commerce) and press releases. Missing data has been gathered by directly contacting the respective firm.

The sample consists of 290 firms and is equally distributed among Europe and Northern America. Until now only preliminary results based on 87 firms can be presented, because the content analysis of collected data is not finalized. The analysis will be extended to the full 290 firms in the next month. The firms are on average 5.7 (std.dev= 6.6, median= 3) years old. The mean value of number of employees is about 87.5 (std.dev= 261.31 median= 5).

According to literature we measure three different business model components, namely value proposition, value creation and value capture. We applied a deductive approach generating dichotomous variables for each business model component (0 = no, 1 = yes).

Value proposition comprises of twelve variables; for example: convenience for the customer or diversity in materials or methods. Value creation comprises of four sub-components: 3D printing technologies, integration of partners, distribution channels, and communication channels. Value capture comprises of two sub-components revenue sources, payment methods.

To identify different patterns in different business model components we applied Latent Class Analysis (LCA) as it has several advantages compared to other classical clustering methods (Magidson & Vermunt, 2002).

Results

Based on the Akaike Information Criteria (AIC) and the calculated classification error of the cluster solutions we selected for each business model component the classification model

which best describes the data. For all three components a final four cluster solution was found. Each case was assigned to the class for which it shows the highest probability.

Value Proposition

Cluster 1 (cluster size 43.04%) scores high in training and support as well as all-round services. Additionally this cluster is characterized by high diversity in offerings. Cluster 2 (35.29%) is characterized by a high degree of flexibility as well as speed. Cluster 3 (13.37%) scores high in quality as well as low-cost offerings. Cluster 4 (8.3%) creates value by making contact to other users, high scores in convenience as well as financial profit.

Value Creation

Cluster 1 (cluster size 35.18%) runs a brick-and-mortar store and applies extrusion-based technologies. Cluster 2 (22.51%) integrates partners into the value creation mechanism. Offerings are distributed either via web shop or resellers. Companies belonging to this cluster communicate with their customers through social media and blogs. Cluster 3 (21.44%) shows predominantly average scores. Cluster 4 (20.87%) shows the highest scores in applying powder, resin, jetting and sinter technologies.

Value Capture

Cluster 1 (cluster size 37.03%) scores high in revenue creation through abonnement and other sources. Payment is either made by credit card or bitcoin. Cluster 2 (25%) is characterized by nonrecurring sales and payment via PayPal, cash as well as bank transfer. Cluster 3 (21.92%) is characterized by high scores in other methods of payment. Cluster 4 (16.05%) is characterized by high scores in contract work and cash on delivery and invoice.

Discussion

Studies focusing on disruptive technologies and the business model have been primarily conceptual so far. The present study examines whether companies in the 3D printing industry commercialize potentially disruptive technologies through conformal or unique business models. We chose to analyze a single industry as it (1) reduces the relative influence of external factors on companies and (2) enables us to analyze existing business model patterns within the 3D printing industry (Morris et al., 2013).

Our study shows that even at this currently nascent stage of the 3D printing industry four distinct clusters for each business model component can be identified. The existence of this heterogeneous clusters displays the wide range of business opportunities as well as numerous potential business models that 3D printing offers. This finding opens up possibilities for future research endeavors. A longitudinal study can provide the opportunity to (1) observe the performance of the surveyed companies over time and thus evaluate the viability of certain business model clusters, (2) investigate potential changes in the business models within clusters or firm's potential movement between clusters and (3) witness the genesis of a dominant industry logic not only ex post but in the curse of its evolution.

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