E-commerce Adoption: A Revelatory Case Study in the German Oncology Pharmaceutical Supply Chain

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Abstract

This paper provides a first longitudinal analysis of B2B e-commerce adoption in the oncology pharmaceutical industry in Germany through a revelatory case study. The analysis shows why and how changes in environmental characteristics happen over time, how these changes promote e-commerce adoption, and why e-commerce is the preferred solution for supply chain participants (compared to other supply chain management practices). The paper advances the existing technology-organization-environment e-commerce adoption literature, and provides rich evidence in support of its models.

Keywords: business-to-business (B2B), electronic commerce (e-commerce, EC), information technology (IT), oncology pharmaceutical industry, revelatory case study, supply chain, technology adoption.

1. INTRODUCTION

Electronic commerce, also called e-commerce or EC for short, has been the subject of many research studies over the last 20 years. Business-to-business (B2B) e-commerce involves the use of Internet-based information technologies (IT) for supporting business transactions between organizations in a supply chain (Chircu, 2014). B2B e-commerce complements other types of IT (such as enterprise resource planning systems, customer relationship management systems, supply chain management systems, and others) that organizations adopt to integrate, with various degrees of success, intra and inter-organizational processes (Crumbly and Fryling, 2013).

While B2B e-commerce revenues are expected to grow to $6.7 trillion by 2020 (Frost and Sullivan, 2015), participation in B2B e-commerce activities still varies significantly by country (Oliveira and Dhillon, 2015). Previous literature has identified a multitude of factors driving B2B e-commerce adoption across the

world. Having many heterogeneous factors as independent variables for e-commerce adoption can be viewed as a signal that more in-depth studies for various countries and industries are needed in order to understand the differential impacts of these variables and shed light on how they influence e-commerce adoption over time and in specific contexts. This paper presents such a study in the context of the oncology pharmaceutical industry in Germany.

This paper is organized as follows. Section 2 describes the relevant literature on e-commerce adoption, section 3 presents the research questions and methodology, section 4 summarizes the analysis, and section 5 presents conclusions and further research directions.

2. RELEVANT LITERATURE

Previous studies have employed the technology-organization-environment (TOE) framework to explain e-commerce adoption. For example, Zhu, Kraemer and Xu (2003) posit that the technology context (competence determined by IT infrastructure, skills and know-how), organizational context (firm scope and size), and environmental context (consumer readiness, competitive pressure, and trading partner readiness) affect the intent to adopt e-business. The model is confirmed using data from 7,500 consumers and over 3,500 firms in 10 European Union countries.

In a related study, Gibbs and Kraemer (2004) posit that e-commerce adoption is influenced by technology resources, organizational factors (perceived benefits, organizational compatibility, financial resources and firm size) and environmental factors (external pressure, government support, and legislative barriers). Their survey of almost 750 companies in 10 countries around the world finds several significant determinants of adoption: technology resources, perceived benefits, financial resources, and external pressure (positive influence) and legislative barriers and country characteristics (negative influence). While industry or firm size do not seem to influence adoption, companies in most countries studied are significantly less likely to adopt e-commerce compared to firms in the United States.

The TOE framework was further confirmed in a recent study of B2B e-commerce adoption in over 7,000 companies in eight sectors in 27 European Union countries (Oliveira and Dhillon, 2015). The results indicate that technology factors (readiness and integration), organizational factors (firm size, worker education, and perceived obstacles), and environmental factors (competitive pressure and trading partner collaboration) significantly affect both e-commerce adoption and routinization (i.e. wide use as part of a firm's value-chain activities). Note that firm size and perceived obstacles are found to negatively affect the dependent variables, while the other factors have a positive influence (Oliveira and Dhillon, 2015).

Consistent with the TOE model, Lin et al. (2008) investigate 26 Australian health care organizations and find that supply chain factors (supply chain management practices, interoperability and partner support) influence their strategic planning process and determine the implementation of B2B e-commerce. Furthermore, by studying healthcare supply chains in the UK, Bakker et al. (2008) find that combinations of organizational and technology internal context factors (such as technology characteristics, organizational characteristics and buying needs) and external context factors (supply chain structure, demand and industry characteristics) lead to different e-commerce adoption outcomes, If internal readiness and external pressures are low, organizations do not adopt e-commerce and instead employ a "wait and see" approach. If internal readiness is high but external pressure is low, organizations adopt e-commerce but may quickly become frustrated with it as suppliers are not ready to join in. If internal readiness is low but external pressure is high, organizations adopt e-commerce due to pressure but risk creating inefficiencies, negative perceptions, and other barriers for benefit realization. Finally, when both internal readiness and external pressures are high, balanced adoption of e-commerce throughout the supply chain is possible (Bakker et al., 2008).

3. RESEARCH QUESTIONS AND METHODOLOGY

As summarized in the previous section, existing research has investigated e-commerce adoption drivers from a TOE perspective and confirmed the significance of technology, organizational and environmental factors using large cross-sectional surveys of companies around the world. Several studies have presented more in-depth case analyses from a supply chain perspective, but the full picture of e-commerce adoption in supply chains is still incomplete. In particular, previous studies have raised the

possibility that industry type and structure are potential important factors in adoption, but few industry-specific studies of e-commerce adoption exist.

If the models presented in the literature review section are correct, then a change in external pressure and internal readiness should enable companies to engage in a balanced adoption initiative – one in which the company and its supply chain partners all benefit from e-commerce. This paper provides a first look at what drives balanced e-commerce adoption in a particular context – the oncology pharmaceutical industry in Germany. The analysis focuses on why and how changes in environmental characteristics happen over time, how these changes promote e-commerce adoption, and why e-commerce is the preferred solution (compared to other supply chain management practices). Thus, the paper advances the existing TOE e-commerce adoption literature by providing a first longitudinal test for its models.

Because this study focuses on how and why questions, a revelatory case study is appropriate (Yin, 1994). As the readers will see in the next section, the company chosen for the analysis, Max Pharma Gmbh, is a first-mover in e-commerce in its industry. In 2014, it developed the first pharmaceutical B2B e-commerce website in the German pharmaceutical market for oncological drugs, and now, two years later, it successfully operates it.

Furthermore, the pharmaceutical industry in Germany is an exemplary setting for this case study since it can shed light on B2B e-commerce adoption in a less studied industry and country. Few researchers have studied e-commerce adoption in healthcare settings in general (Lin et al., 2008). In particular, only 10% of the pharmaceutical supply chain articles identified in a literature review by Narayana, Pati and Vrat (2014) focus on e-commerce (7 articles) or IT applications (3 articles). These papers address process improvement and redesign, compliance management and regulation topics, but more exploratory field research in areas such as the changing configuration of supply chain networks is required (Narayana et al., 2014). As with other operations management topics, supply chains are subject to complex contingent conditions that are difficult to capture in surveys – making case studies ideal for their study (Stuart, McCutcheon, Handfield, McLachlin, & Samson, 2002)

Existing research usually classifies Germany as a lower e-business intensity country (Zhu et al., 2003), and companies in Germany were found to be less likely to adopt e-commerce than companies in other countries such as the U.S. (Gibbs & Kraemer, 2004). Since Germany was recently re-classified in the high readiness group of countries exhibiting both high adoption and routinization of information and communication technology (Oliveira & Dhillon, 2015), it represents an interesting case for investigating contemporary environmental conditions changes and for an in-depth look at a setting where B2B e-commerce adoption is happening in real time.

The research approach followed the case analysis best practices recommended by Yin (1994) and Eisenhardt (1989) regarding triangulation (by using multiple researchers and sources and evidence) and analysis process. Data about the company and its industry was collected through interviews with a top executive, internal company documents (such as press releases, industry communications and reports, e-commerce website pages, etc.), a variety of reports from consulting organizations, industry associations, the European Union, the Organization for Economic Co-operation and Development (OECD) and others, and through direct participant observation. The interviews were conducted in German; their transcripts, as well as other documents in German, were translated in English by one author. All documents were organized into a case database and were analyzed by multiple authors. Insights were derived from the data, compared with theoretical themes derived from the literature review, and verified for face validity by one author (who is an industry expert). Additional questions stemming from the analysis were discussed among the authors and with the company and answered as needed.

4. ANALYSIS

This section presents an in-depth analysis focused on the main e-commerce adoption factors identified as relevant in previous literature: external environmental factors (industry characteristics, partners) and internal organizational factors (firm characteristics and technology readiness). The analysis includes an overview of the pharmaceutical industry characteristics (both globally and in Europe), an investigation of the oncology pharmaceutical industry in Germany and its specific supply chain structure, and an examination of the reasons behind e-commerce adoption at the revelatory

case study company – the German pharmaceutical wholesaler Max Pharma Gmbh.

Pharmaceutical Industry Characteristics: Global and European Trends

Global pharmaceutical sales are predicted to reach $1.4 trillion by 2019 (Deloitte, 2015), a significant increase from $870 million in 2013 (EFPIA, 2014). Europe is the 2nd largest pharmaceutical market after the US, with 27% of industry sales (EFPIA, 2014).

The pharmaceutical supply chains in Europe have a similar high-level structure and contain several players: manufacturers, wholesalers, pharmacies, and point of care providers (hospitals, clinics, etc.) (Kanavos, Schurer & Vogler, 2011). In most European countries, the majority of medication (on average, 60% of sales) is distributed through several major national wholesalers, and the rest through regional wholesalers specializing in a small number of medications (Vitale, 2014). Wholesalers provide important services such as wide assortment of medications, with high in-stock availability and timely and frequent delivery to pharmacies (Kanavos et al., 2011).

Traditionally, the major focus of all supply chain players has been quality of care rather than cost. This requires high availability of the required medicines to meet uncertain patient demand, and increases inventory and distribution costs – especially for manufacturers and wholesalers. As a result, inventory levels in the industry are very high – seven months on average for leading brand-name providers, and five months on average for generic drug manufacturers (McKinsey, 2014).

In most European Union countries, drug prices and margins for supply chain players are highly regulated. The price of drugs is negotiated with the payer – a country's government or approved insurer(s), and is significantly below the list price of the drug. This sets, in effect, a limit on the margins supply chain players can expect in a given country. In addition, wholesale margins are set between approximately 5% and 10%, depending on country (Vitale, 2014). To increase their competitiveness, wholesalers may offer part of their margin as a discount to pharmacies as incentive for buying from them. Thus, wholesalers operate with high volume and very low net margins (Kanavos et al., 2011). Studies show that manufacturers capture 66% of the retail price of drugs, with wholesalers and pharmacies capturing only 5% and 19%, respectively, and the rest being captured by the government (EFPIA, 2014).

Vitale (2014) identifies several competitive trends in the European pharmaceutical sector: horizontal integration (mergers among wholesalers and reduction in the number of overall wholesalers, emergence of pharmacy chains), vertical integration (as changes in legislations have allowed integration, with or without restrictions, between wholesalers and retailers in many countries), direct-to-pharmacy distribution by manufacturers (i.e. wholesaler disintermediation). The regulation of drug prices and of margins for wholesalers and pharmacies is one driver of these trends, with other major drivers being recent developments in both IT and supply chain practices. These are generating opportunities for pharmacies to connect with multiple business partners efficiently and effectively, thus reducing the need for exclusive wholesaler relationships, and triggering potentially significant industry consolidation and change (Kanavos et al., 2011; Vitale, 2014).

Experts characterize today's pharmaceutical industry as having "an inflexible and fragmented supply chain, with long throughput times and lack of agility in operational processes" (McKinsey, 2014, p. 12). Manufacturers looking for competitive advantage are focusing on reducing supply chain costs – with inventory and obsolescence costs as primary targets as these can account for, on average, almost half of the total supply chain cost (McKinsey, 2014).

Experts predict that the pharmaceutical industry will be characterized by increased volatility in years to come, making demand forecast difficult. The use of tenders (discounts negotiated with the payers – insurers or government - in exchange for being listed as an approved supplier of the drug), especially for generic medication, increases volatility in the marketplace by shifting demand to the tender winners (McKinsey, 2014). Volatility is further increased as regulatory agencies can withdraw approval from manufacturers due to quality problems, as manufacturers withdraw a drug from the market due to unexpected side effects, or as natural disasters disrupt established supply chains and create shortages. All these events create opportunities for the remaining players to meet the additional demand (McKinsey, 2014).

The industry is also subject to globalization pressures (Sultanow and Kretzer, 2014) for both research and development (R&D) and production

activities. Worldwide competition, especially from developing countries such as China and India, is increasing, fueled in part by the lack of legislation, such as patent protection, in some of these countries. For example, between 1970 and 2005, no effective patent protection existed in India, enabling extensive copying of western drug preparations by Indian pharmaceutical manufacturers, who then started producing these drugs locally using alternative processes. These manufacturers avoided significant R&D investments - which usually are in the hundreds of millions of euros range - and the associated risks, and gained a better competitive position (Perlitz, 2008). As these companies enter the German or other European pharmaceutical markets with lower research and development costs, they are able to offer products at lower prices, leading to increase price competition in the industry as incumbents are trying to adapt.

Overall, the analysis indicates that the environmental conditions in the pharmaceutical industry are changing. These changes create pressure for pharmaceutical industry players to save cost, identify additional sources of revenue, and maintain competitive advantage. Experts advise that supply chain improvements are one way of achieving this, and that planned improvements should target four key supply chain metrics: service levels, cost of supply chain, capital requirements, and capabilities (McKinsey, 2014).

Oncology Pharmaceutical Supply Chains in Germany

Compared to other countries in Europe, Germany ranks higher for pharmacy expenditures per capita (over 11% of GDP in 2011), and tends to provide drugs to patients much quicker (EFPIA, 2014; Tost, 2015).

However, in developed pharmaceutical markets such as Germany there is increased pressure to reduce costs and improve efficiency (McKinsey, 2014; Deloitte, 2015). Changes in German legislation in 2012 created significant price pressure on pharmaceutical manufacturers. While manufacturers were free to set drug prices prior to the new legislation, they are now required to negotiate (sometimes steep) discounts over the list price of their medication. For example, the law has further increased the price discounts of proprietary medication for oncology cytostatic preparation in favor of health insurance providers – to 25, 30 or even over 45% levels (Heni-Software, 2014). The reduction in payments to pharmacies results in increased price pressure on upstream participants (wholesalers and manufacturers), who now have to provide the drugs at lower prices and reduce their margins.

Mandatory discounts can save money for the German Statutory Health Insurance, but they in turn reduce pharmaceutical industry profits by billions of euros per year (IMS Health, 2011). Industry insiders argue that the price of drugs has been falling too much – even below the European average for some medications (Tost, 2015). The corresponding reduction in manufacturer and wholesaler profits can have significant further negative effects on the industry, resulting in increased concentration and decreased competition. Because of large R&D expenses, and the large time window between successful drug R&D and commercialization, even large companies with large financial resource need to look for cost-savings opportunities, leading to more consolidation. This may lead to German companies losing jobs, research competences and global rankings (Hoffritz, 2004). Recently, the compound annual growth rate for the German pharmaceutical market has been declining (McKinsey, 2014). This matches the trends observed for the life sciences sector globally, where negotiated discounts, price controls and restrictions in care authorization and purchasing policies are predicted to erode margins into 2016 and beyond (Deloitte, 2015).

The market for oncological (cancer) drugs in Germany is highly competitive – especially in the area of generic cytostatics (a special type of infusion chemotherapy drugs that inhibit cancerous cell growth and multiplication). Cytostatic drug preparations that have been on the market for a long time are now competing with newer oral oncology drugs and focused therapy management – which both lead to a reduction of infusion preparations. In this area, patients and doctors are not very concerned about brand name medication, and generic medication are believed to provide similar benefits to branded drugs as long as their production follows legal and manufacturing requirements. In addition, pharmacies can also become manufacturers for cytostatic solutions (as permitted by the German Medicines Act), further increasing competition. As a result, competition among manufacturers focuses on price, rather than quality, service or brand name (Sultanow & Kretzer, 2014).

As manufacturers experience increased price pressures from regulation changes and new entrants, they are looking at ways to decrease supply chain costs. For example, manufacturers can disintermediate wholesalers and connect directly to retailers (pharmacies or hospitals) (Vitale, 2014).
Wholesalers are also under pressure due to mandatory restrictions on margins, and increased competition from new wholesale licenses, which can now be awarded to pharmacies, not just to the actual providers of distribution services. Many pharmacies use these licenses to buy drugs at the wholesaler discount and trade with each other, thus competing with established wholesalers and further squeezing their margins (Sultanow & Kretzer, 2014).

In conclusion, the German pharmaceutical industry, in general, and the oncology industry, in particular, have been experiencing significant environmental changes, not only because of global industry trends but also because of country-specific regulatory changes. Manufacturers and wholesalers in this industry are especially affected. Available evidence indicates that these changes will continue and, in some cases, amplify in the future as well.

E-commerce Adoption at Max Pharma

Max Pharma GmbH operates as a full-range and full-line national pharmaceutical wholesaler in Germany, in accordance with the country's Medicinal Products Act (AMG). The company supplies pharmacies and hospitals nationwide with medicines in the field of oncology. It has annual sales of 40 million euros, and serves about 300 customers – a majority of the oncological sector retailers. The company competes with other large German national wholesalers such as the PHOENIX group, Alliance Boots (now part of the Walgreens Boots Alliance), and GEHE.

Max Pharma is positioning itself as a leading fast and reliable wholesaler that can help pharmacies and hospitals maintain high quality of care. To achieve this goal, the company has developed innovative technology to support good manufacturing practices (GDP) standards and ensure temperature monitoring and counterfeit protection for all drugs it distributes.

Customer demand for drugs is variable, with higher levels at the beginning of the month. A large percentage of customers order on average twice a week. The other orders vary over time, from daily to rarely. The order size is fairly large – between 10,000 and 100,000 euros. Orders for regularly priced products come in by phone (80%), fax (15%), and email (5%), reflecting a general preference among industry players for maintaining personal business relationships through traditional communication channels.

As other wholesalers, one of Max Pharma's primary objectives is to ensure high levels of customer service – i.e. being able to fulfill all customer orders quickly. This goal is shared by manufacturers as well. As a result, both the wholesaler and the manufacturer focus on maintaining adequate inventory levels and production schedules to meet demand without stock-outs. Manufacturers produce the drugs in large batches (which ensure production cost savings and thus higher margins). Most drugs have a relatively long shelf life - five years for uncomplicated molecules, three years for small molecules, and 18 months for biotechnology drugs.

However, the analysis indicates that determining the optimal quantity to produce at any given time is tricky. In order to ensure high in-stock service levels, manufacturers make drugs to stock, and carry a large safety stock (Kanavos et al., 2011; McKinsey, 2014; Vitale, 2014). Occasionally however, due to increased volatility, stock-outs do occur. Although manufacturer reputation is not usually affected, these stock-outs create opportunities for other players to step in, resulting in reduce competitive advantage and profits, as discussed in a previous section. In addition, customer service levels are affected, resulting in delays at the point of care. The interview data reveals that, perhaps in order to avoid the negative consequences of stock-outs, manufacturers overestimate demand, and produce too much.

The data indicates that solving the inventory management problem is challenging. This may be due to the (relatively) short shelf life of drugs and unanticipated demand fluctuations (Vila-Parrish & Ivy, 2013). Even when companies want to reduce inventory levels and the associated cost, they cannot do so due to market volatility and desired (or required) high service levels. Managing inventory across the entire supply chain under real-world conditions involving multiple drugs and variable lead times, payment delays, space availability and customer service levels may require advanced optimization and simulation (Uthaykumar & Priyan, 2013; Vila-Parrish & Ivy, 2013). Such advanced practices may not in fact be widely

applicable in practice. Instead, the company in this study study builds on years of experience to understand demand, rather than using statistical models. In addition, collaborating with customers on planning, forecasting, and replenishment is not feasible, in company's opinion, because patient arrivals and diagnoses cannot be forecasted. Even if the morbidity rates are known in the population, patient diagnoses and needs for specific drugs are unpredictable.

As a result, the oncology supply chain Max Pharma operates in often has excess inventory. As these drugs approach their expiry date (and are classified as short-dated), manufacturers have to deal with the cost of obsolesce (McKinsey, 2014) by wasting or destroying the drugs, as required by law. This can be a significant percentage (over 25%) of overall distribution costs (Vila-Parrish & Ivy, 2013).

To solve the obsolete inventory problem, Max Pharma has developed an e-commerce solution enabling the sale of short-dated drugs online, at a discount. The company is a pioneer in this area in Germany (B2B e-commerce selling, or liquidation, of short shelf life oncology drugs). Its competitors do not use e-commerce yet – instead, they call customers directly with offers for short-dated drugs at a discount, or send fax advertisements. Even if some wholesalers provide e-commerce ordering for regularly priced drugs, they have not extended those systems to short-dated drugs.

The analysis indicates that an important driver of e-commerce adoption in Max Pharma's case is not competitive pressure from other e-commerce implementations, but pressure from changing environmental conditions (as described in detail in previous sections). Sensing these changes, Max Pharma moved swiftly and became a first mover for the selling of short-dated drugs with e-commerce technology.

Another driver of successful adoption is the technology readiness of the company. Although Max Pharma has a small IT department, it employs highly experienced developers and administrators, who have successfully developed applications from scratch and implemented standard applications without major challenges (including logistics, warehouse and tracking, and ERP systems, among others). The e-commerce website was developed internally over nine months, without glitches. Usability has been a major criterion, and successful consumer e-commerce sites such as Amazon.com were used as inspiration. The website is provided in English, German and Chinese.

Business partner readiness has been another determinant of success. During the first months of operations, the e-commerce website attracted offers from 10 manufacturers, and both existing and new customers (mostly pharmacies, but also other wholesalers interested in taking advantage of the low prices and hospitals). The participating manufacturers provide the information of short-dated drugs to Max Pharma for posting on the website. Then they either send the drugs to the wholesaler for distribution (in a traditional wholesale model) or ship the drugs directly to customers as orders come in (in a marketplace model). Unsold drugs are destroyed according to European Union rules for toxic waste destruction. In both models the manufacturer pays for the delivery service (packing and shipping). The wholesaler is paid a percentage of the sales (based on the legally allowable margin and discounted selling price).

Internal benefits for Max Pharma include, among others, cost reduction through order process automation, increased global visibility 24/7, new customer acquisition – in Germany, Europe and worldwide, and customizations of offers for customers (through recommendations, analysis of wish lists, price alerts, etc.).

Benefits for manufacturers include cost savings - selling the excess short-dated drugs before expiration is more profitable than discarding them, and saves the cost of disposal (which can be significant). The interview data reveals that manufacturers are very excited about the e-commerce website as a new distribution channel. The wholesaler e-commerce solution improves the manufacturer's understanding of customer demand without the associate costs of establishing direct-to-customer relationships (as in a disintermediated model). As a result, manufacturers can begin to optimize inventory management, replenishment and logistics.

For pharmacies, the e-commerce solution represents a way of reducing costs as well. While pharmacies do not use the e-commerce site to buy discounted cytostatic drugs in advance for long-term use, they find it very useful in order to meet short-term patient demand. This matches the drug administration processes – in the oncological field, drugs are often used on the same day or at most the day after delivery, so ordering in advance at the pharmacy level is not feasible. However, just in

time, patient-driven ordering and the short time between delivery and use makes short-dated drugs a viable, lower-cost alternative since there is no risk of these drugs expiring before use.

The interview data points out that one challenge that remains across the industry is that pharmacies need to change their mindset in order to accept more short-dated products. To this end, in order to build recognition for the website as a valid ordering channel, the e-commerce website is regularly advertised in leading oncology journals, under a leading online news portal for pharmacies (Apotheke Adhoc, http://www.apotheke-adhoc.de/), and with flyers included with regular customer orders.

Obviously, as others have noted in past research, e-commerce can increase price competition if customers become accustomed with discounts. However, the data collected for this paper reveals that, in the oncology market, the threat of price competition is minimized due to the nature of demand. Patients and their doctors are not able to wait until short-dated drugs are available – they need specific medication for treatment right away. Thus, most orders are filled using regularly-priced products – as pharmacists need to fill doctor orders as they come in. If a discounted short-dated drug is available at the time of ordering, the pharmacist may decide to order it instead, but the pharmacist cannot delay the order until an individual cytostatic drug is available at a special price. Thus, the short-dated drug selling model remains a push model (from manufacturer) rather than a pull model (based on patient/pharmacy demand).

5. CONCLUSIONS AND FUTURE RESEARCH

This paper presents one of the first longitudinal analyses of e-commerce adoption from a TOE (technology, organization, and environment) perspective. The paper complements existing cross-functional e-commerce adoption studies, and helps further test existing models (Bakker et al., 2013) in a new context – the oncology pharmaceutical supply chain in Germany. The paper contributes to theory extension and refinement by showing the applicability of the existing models to a different setting and teasing out some of the associated complexity and contingencies (Stuart et al., 2002).

Whereas TOE describes environmental pressures quite generically and rightly so, this paper provides an in-depth analysis of such pressures. Through a revelatory case study, the paper shows why and how changes in environmental characteristics – both globally and in Germany - happen over time, how supply chain players react, and how e-commerce emerges as a valuable solution for the entire supply chain. The case describes how companies can develop technology by capitalizing on internal competencies during regulatory and industry changes.

One of the limitations of this case study is the focus on a single company, industry and country. However, single case studies are an appropriate form of investigation when they serve revelatory or longitudinal purposes (Yin, 1994). The in-depth analysis of the impact of changes in environmental conditions on e-commerce adoption fits both of these criteria. Further research can study additional longitudinal environmental, organizational and technology change processes and their impact on e-commerce adoption in other industries and countries. Future studies can also investigate this type of technology adoption as a first step in an iterative strategic process that takes advantage of first mover advantages and network effects. Ultimately, this will help test and refine existing theories of e-commerce adoption based on the technology-organization-environment framework.

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7. REFERENCES

Bakker, E., Zheng, J., Knight, L., & Harland, C. (2008). Putting e-commerce adoption in a supply chain context. *International Journal of Operations & Production Management, 28*(4), 313-330.

Chircu, A. M. (2014). E-Commerce. In D. Straub & R. Welke (Eds.), *Wiley Encyclopedia of Management*, John Wiley & Sons: Chichester, England.

Crumbly, J., & Fryling, M. (2013). Rocky relationships: Enterprise resource planning and supply chain management. *Journal of Information Systems Applied Research, 6*(2), 31-39. Retrieved July 7, 2016 from http://jisar.org/2013-6/.

Deloitte (2015). 2016 Global life sciences outlook: Moving forward with cautious optimism. Retrieved July 7, 2016 from http://www2.deloitte.com/global/en/pages/life-sciences-and-healthcare/articles/global-life-sciences-sector-outlook.html.

EFPIA (2014). The pharmaceutical industry in figures. Retrieved July 7, 2016 from www.efpia.eu.

Eisenhardt, K. (1989). Building theories from case study research. *Academy of Management Review, 14*(4), 532-550.

Frost & Sullivan (2015, April 9). The global B2B e-commerce market will reach 6.7 trillion USD by 2020, finds Frost & Sullivan. Retrieved July 7, 2016 from http://ww2.frost.com/news/press-releases/.

Gibbs, J. L., & Kraemer, K. L. (2004). A cross-country investigation of the determinants of scope of e-commerce use: an institutional approach. *Electronic Markets, 14*(2), 124-137.

Heni-Software (2014). Änderung Hilfstaxe 2014. Retrieved July 7, 2016 from http://www.heni-software.de/index.php/unsere-produkte/infos-auf-einen-blick/119-aenderung-hilfstaxe-2014.

Hoffritz, J. (2004). Der deutsche Patient. *Zeit-Online*. Retrieved August 30, 2008 from http://www.zeit.de/2004/06/Pharma.

IMS Health (2011). AMNOG-Einsparungen im ersten Jahresdrittel 2011: Zwangsrabatte überschreiten bereits die Milliardenmarke. Retreived August 25, 2011 from http://www.imshealth.de/de/artikel/id/15375.

Kanavos, P., Schurer, W., & Vogler, S. (2011) The pharmaceutical distribution chain in the European Union: Structure and impact on pharmaceutical prices. *European Commission*, Brussels, Belgium. Retrieved July 7, 2016 from http://eprints.lse.ac.uk/51051/.

Lin, C., Huang, Y., Jalleh, G., Liu, Y. & Tung, M. (2010). An exploratory study of factors affecting adoption and implementation of B2B e-commerce in Australian health care organizations. *, 1*(2), 77-96.

McKinsey (2014). Finding opportunity in uncertainty: A new paradigm for pharmaceutical supply chains. Retrieved July 7, 2016 from http://www.mckinsey.com/industries/pharmaceuticals-and-medical-products/our-insights/finding-opportunity-in-uncertainty-a-new-paradigm-for-pharmaceutical-supply-chains.

Narayana, S. A., Pati, R. K., & Vrat, P. (2014). Managerial research on the pharmaceutical supply chain - A critical review and some insights for future directions. *Journal of Purchasing and Supply Management, 20*(1), 18-40.

Oliveira, T., & Dhillon, G. (2015). From adoption to routinization of B2B e-Commerce: Understanding patterns across Europe. *Journal of Global Information Management, 23*(1), 24-43.

Perlitz, U. (2008). Indische Pharmaindustrie auf Globalisierungskurs. *Deutsche Bank Research*, 413.

Stuart, I., McCutcheon, D., Handfield, R., McLachlin, R., & Samson, D. (2002). Effective case research in operations management: a process perspective. *Journal of Operations Management, 20*(5), 419-433.

Sultanow, E., and Kretzer, M. (2014). Publication information omitted during review process for anonymity. *Onkologische Pharmazie, 16*(4), 54-57.

Sucker, K. (2011, June 27). Kassen regeln Näheres zum Impfstoffabschlag. *DAZ.online.* Retrieved June 27, 2011 from http://www.deutsche-apotheker-zeitung.de/politik/news/2011/06/27/kassen-regeln-naeheres-zum-impfstoffabschlag.html.

Tost, D. (2015, June 17). Germany ranked among Europe's biggest pharma spenders. *EurActiv.de.* Retrieved June 10, 2016 from http://www.euractiv.com/section/health-consumers/news/germany-ranked-among-europe-s-biggest-pharma-spenders/.

Uthayakumar, R., & Priyan, S. (2013). Pharmaceutical supply chain and inventory management strategies: Optimization for pharmaceutical company and a hospital. *Operations Research for Health Care, 2*, 52-64.

Vila-Parrish, A. R., & Ivy, J. S. (2013). Managing supply critical to patient care: An introduction to hospital inventory management for pharmaceuticals. In B. T. Denton (Ed.), *Handbook of Healthcare Operations Management: Methods and*

Applications (pp. 447-463), New York, NY: Springer.

Vitale, C. (2014). Competition issues in the distribution of pharmaceuticals: Contribution from the European Union. *OECD Global Forum on Competition*, February 27-28, 2014. Retrieved July 7, 2016 from http://www.oecd.org/competition/competition-distribution-pharmaceuticals.htm.

Yin, R. K. (1994). *Case Study Research* (2nd ed.). Beverly Hills, CA: Sage Publications.

Zhu, K., Kraemer, K. L., & Xu, S. (2003). Electronic business adoption by European firms: a cross-country assessment of the facilitators and inhibitors. *European Journal of Information Systems, 12*(4), 251-268.