Association for Information Systems
AIS Electronic Library (AISeL)

PACIS 2018 Proceedings

Pacific Asia Conference on Information Systems (PACIS)

6-26-2018

How do IT capabilities support fast delivery of big data services to clients across industries?

Xiaolin Zhu
School of Business, Renmin University of China, zhuxiaolin@ruc.edu.cn

Chong Ma
School of Business, Renmin University of China, xbzhtx@ruc.edu.cn

Fang Su
school of management, Jinan University, sf.830@163.com

Ji-Ye Mao
School of Business, Renmin University of China, maojiye@rmbs.ruc.edu.cn

How do IT capabilities support fast delivery of big data services to clients across industries?

Completed Research Paper

Xiaolin Zhu
School of Business, Renmin University of China
No.59, Zhongguancun Avenue, Haidian District, Beijing 100872, China
zhuxiaolin@ruc.edu.cn

Chong Ma
School of Business, Renmin University of China
No.59, Zhongguancun Avenue, Haidian District, Beijing 100872, China
xbzhtx@ruc.edu.cn

Fang Su
School of management, Jinan University
No.601, West Huangpu Avenue, Guangzhou, Guangdong 510632, China.
sf.830@163.com

Ji-Ye Mao
School of Business, Renmin University of China
No.59, Zhongguancun Avenue, Haidian District, Beijing 100872, China
maojiye@rmbs.ruc.edu.cn

Abstract

IT capabilities have been an important research area, especially in the big data era, when much business value can be drawn from external data. This study reports an interesting phenomenon, the transformation of an internal IT department of a traditional manufacturing company into an IT service provider. It adopts the single case study approach to explaining how the newly transformed business unit rapidly delivers IT services to external clients across industries. Results show that the IT service providers can provide fast service delivery to different clients across industries through developing digital assets, bridging business-data and standardizing services/products, which interact with each other. The whole process of service delivery is supported by IT capabilities such as IT infrastructures, IT managerial skills and IT technical skills. We extend the IT capability and IT service provider literature to the big data context.

Keywords: IT capabilities, IT service provider, big data era, service delivery

Introduction

With the widespread adoption of e-Commerce, social media, Internet of Things, and cloud computing, the acquisition of external data is becoming more convenient and efficient than before (Chen et al. 2012; Pauleen and Wang, 2017; Agarwal and Dhar, 2014; Lodha et al. 2014). Therefore, the era of big data has brought tremendous opportunities and challenges for firms. Proper management of external data allows firms to grasp market trends accurately, understand a product from multiple perspectives, and react to the market rapidly (Chen et al. 2013). Naturally, firms begin to focus on revealing valuable information through massive external data by developing necessary IT infrastructures and skills (Intezari and Gressel 2017). In the process of analyzing external data, firms have developed capabilities to cope with big data, namely big data analysis capabilities, which constitute part of IT capabilities (Yoon 2011).

IT capabilities have been a focus of research, because they can maintain a firm's core competitive advantage and promote performance (Bakan and Sekkell 2017; Pauleen and Wang 2017). IT capabilities tend to evolve over time in alignment with the changing environment (Ethiraj et al. 2005). Under the traditional scenario which differs from the big data era, most studies used to analyze IT capabilities based on internal data (Bharadwaj 2000; Chae et al. 2014; Chen and Tsou 2012; Chen et al. 2014; Stoel and Muhanna 2009; Ravichandran and Lertwongsatien 2002; Santhanam and Hartono 2003). IT capabilities should have new interpretations in the big data era, which have not been discovered yet in the extant literature. This research focus on revealing the value of IT capabilities on analyzing external data.

This study is part of a larger research project that examines firms not only developed the capability to take advantage of external data to support self-development, but also managed to transform this capability into standardized products delivered to clients. Midea is the best example. Before established, MeiCloud was a part of IT process department of Midea Group, which was the biggest appliance manufacturer in China ranking in the Fortune 500. After accumulating rich experience through providing IT-related services for Midea Group, MeiCloud was set up as a subsidiary to provide big data services for external clients. Among the diverse products of MeiCloud, "Kepler Observatory" was a star product, which took advantage of external big data to reveal information beyond intuition and allowed rapid reaction to the fast-changing business environment. MeiCloud acquired more than 45 external clients from various industries, such as airline, real estate, and clothing, within its first year of foundation. Many of the external clients were among the top three in their respective industry. This remarkable success begs the questions of how could MeiCloud make fast delivery of IT services to clients in various industries?

Neither studies on IT capabilities nor research on IT service providers can a convincing explanation for this phenomenon. First, prior research on IT capabilities tries to identify the value of IT capabilities to firms from a client's perspective. That is, IT capabilities are usually suited for a certain business process. However, in the phenomenon we observed they are used in different business processes across industries. It is not clear how do IT capabilities support services across industries, especially with fast service delivery. Second, research on IT service providers mostly focuses on operational capabilities instead of IT capabilities, which are more general and pay less attention on technical capabilities. Moreover, we intend to identify any potential differences in IT capabilities for support service delivery between traditional IT services and big data analysis services.

Therefore, we adopt the case study method to explore IT capabilities in this new context, big data analysis, to address the following research question from a provider's perspective, *how do IT capabilities support fast delivery of big data analysis services to clients across industries?*

The reminder of this paper is organized as follows. First, we review relevant research on IT capabilities and IT service providers' capabilities. Then we explain our choice of research method for collecting and analyzing the data, followed by an overview of the case. Subsequently, we present the results of data analysis. Lastly, we discuss the contributions this paper to research and practical implications, along with limitations and directions for future research.

Literature Review

IT Capabilities

Over the past two decades, IT capabilities have been a focal research topic. Among the first studies of IT capabilities in the academic field was in the one by Ross et al. (1996), which defined IT capabilities as the capacity to control IT-related costs, deliver systems when needed, and affect business objectives via IT implementation. Drawing from the resource-based view (RBV), Ross et al. proposed three types of IT assets, human, technology, and relationship. Together they shape the IT capability of a firm, and help the firm realize business value ultimately.

Since then, a rich body of literature about IT capabilities has been produced on the definition and constructs (Bataineh 2015; Bharadwaj et al. 1999; Bharadwaj 2000; Bhaat and Grover 2005; Chen and Tsou 2012; Stoel and Muhanna 2009; Wade and Hulland, 2004), the link between IT capabilities and market agility (Bataineh 2015; Chen et al. 2014; Tallon 2007; Lu and Ramamurthy 2011; Yoon 2011), the relationship between IT capabilities and organizational/firm performance (Bharadwaj 2000; Chae et al. 2014; Chen and Tsou 2012; Chen et al. 2014; Stoel and Muhanna 2009; Ravichandran and Lertwongsatien 2002; Santhanam and Hartono 2003), the connection between IT capabilities and competitive advantage (Bhaat and Grover 2005; Fink 2011). Most studies are based on RBV, regarding IT capabilities as a combination of IT resources being specific, rare, difficult to imitate or substitute to gain sustainable competitive advantage, which are consistent with the first study. For instance, Bharadwaj (2000) described IT capabilities as the abilities to integrate and deploy IT-based resources in combination with other resources and capabilities. Furthermore, three dimensions of IT-based resources are proposed to constitute IT capabilities, including IT infrastructures, IT human resources, and IT-enabled intangibles, which are mostly accepted constructs to be the basis of many subsequence studies. Moreover, IT human resources can be divided into managerial IT skills and technical IT skills according to different effects they make.

Our review of the prior literature suggests that almost all of the studies chose to discuss how do IT capabilities support firms themselves, that is, a particular business process o gain competitive advantage or improve performance from a client’s perspective (Bharadwaj 2000; Bhaat and Grover 2005; Chae et al. 2014; Fink 2011; Stoel and Muhanna 2009; Ravichandran and Lertwongsatien 2002; Santhanam and Hartono 2003). It is still unclear whether IT capabilities can support disparate business processes from different industries, and how do they support service delivery across industries, especially when the speed of service delivery is extremely fast.

IT service providers’ capabilities

An examination of the literature reveals that most studies concerning capabilities from a provider's perspective have focused on the operational capability (Ethiraj et al. 2005; Jarvenpaa and Mao 2008; Levina and Ross 2003; Rajkumar and Mani 2001). For instance, Levina and Ross (2003) proposed that IT providers should have the capabilities to address client needs and market conditions, exhibit complementarities resulted in efficient service delivery and decision rights from multiple clients in realizing value proposition. To this extent, Jarvenpaa and Mao (2008) further concluded operational capabilities of IT providers consist of three dimensions including client-specific capabilities, process capabilities, and human resources capabilities.

Different from operational capabilities mentioned above, IT capabilities from a provider's perspective have received little attention, although IT capabilities mean a lot to IT service providers. Exploring IT capabilities from a provider's perspective is of value regarding the following three aspects: (1) The concept of operational capabilities refers to the competence managing the whole outsourcing service process resulting provider's value position (Levina and Ross 2003), while IT capabilities are specific capabilities managing IT-related resources, which are most important for firms to gain competitive advantage (Bharadwaj 2000; Ross et al. 1996). Hence, the boundaries of them are different, making operational capabilities more general in a lager scope, and IT capabilities more focused. (2) Operational capabilities pay less attention to technical capabilities than IT capabilities. Taking IT infrastructures as an example, it is a part of essential dimensions of IT capabilities reflecting IT technology level (Bharadwaj 2000), while in operational capabilities it is just a part of process capabilities which are not emphasized (Levina and Ross 2003; Ethiraj et al. 2005). Since there is no doubt that technology plays a very important role in digitized IT service process, we should investigate how do IT capabilities support service delivery. (3) Operational capabilities discussed in existing research are not able to reveal how do firms provide fast cross-industries’ service delivery. Client-specific capabilities focusing on the alignment of provider activities with the client’s needs should differ across industries even across different clients (Jarvenpaa and Mao 2008; Levina and Ross 2003). This is not a reason but a contradictory conclusion to the phenomenon of fast delivery across industries.

Therefore, although the operational capabilities have overlaps with IT capabilities from provider's perspective, it is necessary to give an accurate explanation of how IT service providers provide fast cross-industry service delivery. Therefore, we intent to make contributions to IT service providers' literature by analyzing the differences between traditional IT service providers' capabilities and the newly transformed firms' big data analysis capabilities.

Data-oriented IT Capabilities in the Big Data Era

Research on IT capabilities in the big data era also has a new expansion (Agarwal and Dhar 2014). The easy access to external data can create great value by analyzing with effective tools and methods (Chen et al. 2012). Therefore, it is a new perspective for scholars to look into IT capabilities through external data analysis. This paper will be an exploration of IT capabilities from a provider's perspective to answer how do firms serving across industries quickly.

Research Methods

To address the research question, we adopt the single case study approach as our research method (Yin 2013). In particular, we focus on services based on Kepler Observatory as the unit of analysis. Kepler Observatory, provided by MeiCloud, is a product in accessing, processing and analyzing Internet data. Kepler Observatory have provided big data services to nearly 40 clients coming from over 20 industries up to now, including home appliance, toy, auto, winery, clothing, retail, new energy, daily chemical industries, etc. Therefore, it is suitable for our research context.

Case settings

MeiCloud is a subsidiary of Midea Group. As early as 2014, Midea Group has already handled with internet data to support product life-cycle management. In January 2017, MeiCloud was formally established as a subsidiary and began to undertake external orders. MeiCloud has grown up to a leader and the benchmark in big data products and applications in China and have developed a large number of external clients for a short period of one year.

As a star product of MeiCloud, Kepler Observatory assists all phases in product life-cycle management, such as product planning, quality management, brand management, through collecting, processing and analyzing Internet data. Kepler Observatory can assist firms in grasping an industry's competition situation and products feedback information in time through accessing and analyzing big data from the Internet.

Data collection

We collected our data in three ways. First, the research team collected interview data in August 2017 and January 2018 on the spot. We conducted semi-structured interviews, one member followed the interview template focusing on the development process of MeiCloud, the products and services provided by MeiCloud (especially Kapler Observatory), and how MeiCloud collaborates with internal clients (Midea) and external clients. Most of interviews last 60-90 minutes (Table 1). Second, we collect data from field observation. The first author and the second author have spent for 3 months and 1 months respectively in MeiCloud as internships, they knew well about Kepler Observatory and attended internal meetings. Third, we attended several marketing activities about introducing products of MeiCloud (e.g., Kepler Observatory) to external clients and several internal meetings, such as project kick off and acceptance meeting. These marketing activities and meetings help us to have a better understanding of Kepler Observatory.

Table 1. Data Sources

Data sources	Interviewees	Interviews/recordings (time length: hours)
Interviews (Jul. 2017)	The product director of Kepler Observatory; The Leader of business analysis team	3 (2.5h)
Interviews (Aug. 2017)	The product director of Kepler Observatory; The leaders of business analysis team, data ETL; Project managers	6 (5.5h)
Interviews (Jan. 2018)	The general manager of MeiCloud; The product director and project managers of Kepler Observatory; The general manager; The IT director of Midea small appliance business division	11 (13.5h)
Marketing activities and meetings		4 (6 h)
Total		24 (27.5h)

Data analysis

The data analysis was a three-step, grounded iterative process (Strauss and Corbin 1998; Huang et al. 2017). First, we conduct open coding, we found 8 second-order themes, such as indicator systems formed based on business topics, report systems formed based on business logic, big data acquisition and analysis. The second stage of analysis was based on the principle of axial coding, we derive three mechanisms according to 8 second-order themes and labeled them as bridging business-data, developing digital assets and standardizing service/product (Figure 1). Finally, we generated a whole model of rapid delivery of digital products. We conducted selective coding to find out interactions of three mechanisms. The outcome resulting from this stage of data analysis was a conceptual model of fast delivery of digital products provided by IT service providers.

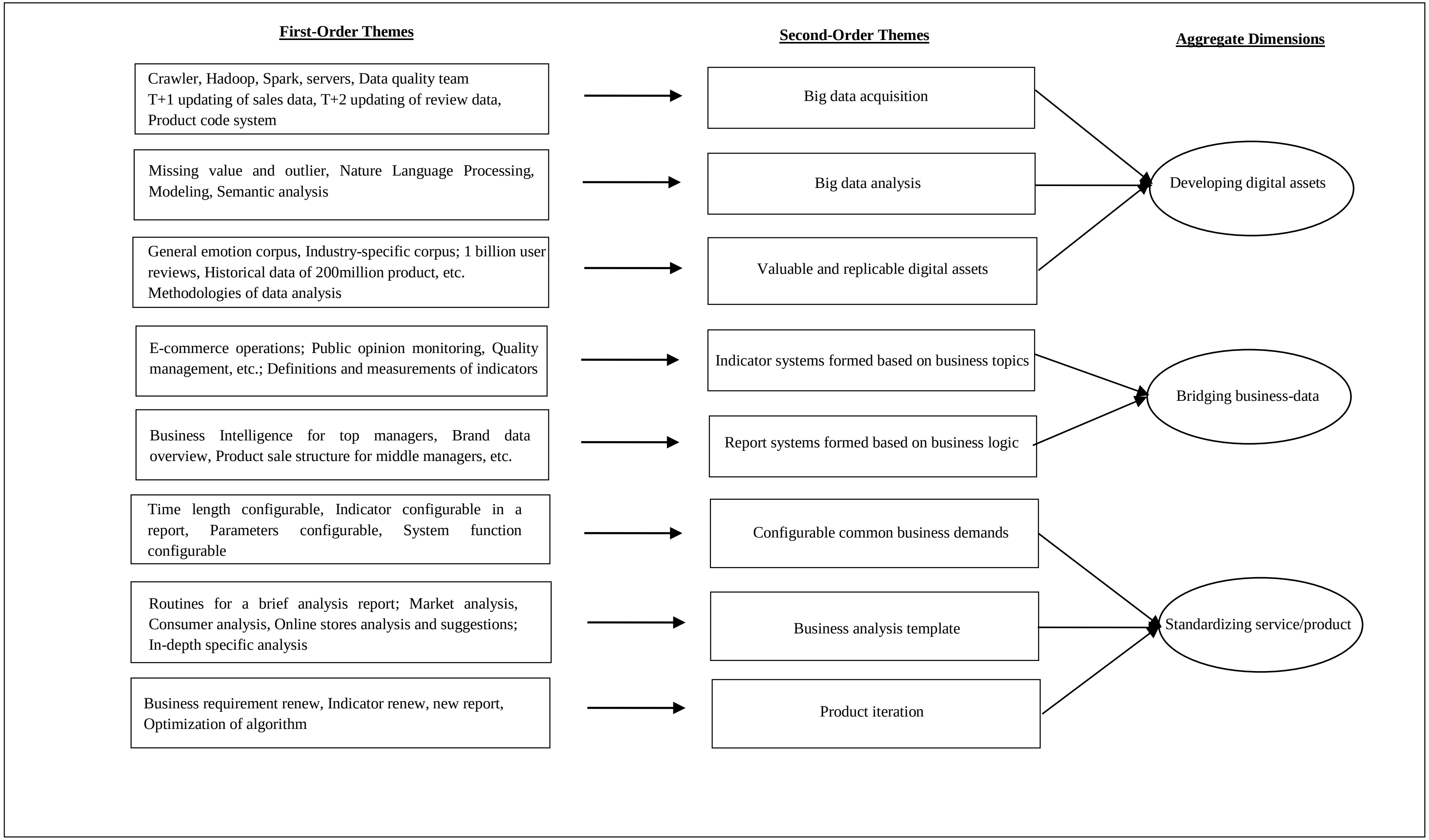

Figure 1. Data structure

Findings

Through data analysis, we find that the reason Kepler Observatory achieves fast delivery to clients in various industries lies in its accomplishment of three mechanisms: developing digital assets, bridging business-data, standardizing service/product.

Developing Digital Assets

Developing digital assets refers to forming valuable and replicable digital resources through a general methodology of accessing and processing external data. Up to July 2017, Kepler Observatory has crawled historical data of over 1 billion reviews, 200 million products, 50 million online stores, 500 product categories, and 200 thousand brands in over 20 industries. The volume of data has exceeded 800TB. Both clawing and processing/analyzing external data cannot work without IT-based resources.

Big data acquisition

Big data acquisition methodology refers to principles, technology rules and procedures of accessing big data. High volume internet data is accessed through web crawler algorithm. Capturing target data rapidly and precisely poses big challenges for crawler technology (Olston and Najork 2010). Kepler Observatory does a good job.

MeiCloud owns more than 150 servers distributed throughout the country which can be mapped into 350 virtual servers. Those virtual servers emulate actual human operations on the web to avoid detections of anti-crawling in some websites. Based on the excellent technology of web crawler, Kepler Observatory can crawl whole pages information on some major e-commerce websites, vertical websites, social media platform, and crawl over 90 percentage of page information on websites that have sophisticate real-time anti-crawling techniques (e.g., Tmall.com, JD.com).

Kepler Observatory should finish preparation before web crawling. Firstly, confirming product categories according to the underlying product code system of Tmall.com. This rule can avoid crawling irrelevant products that seem like but actually not the focal product, for example, “mobile phone” and “mobile phone shell”. Secondly, preparing basic data, such as keywords, product parameters, price ranges, and brands. The basic data provides crawling targets, which improve the accuracy of data accessing. The basic data should be confirmed together with clients.

Kepler Observatory daily updates the previous day’s sales data and the previous two days’ review data. For public sentiment data, Kepler Observatory crawls data on websites per 20-30minutes for focal clients, while crawling competitors’ daily.

To ensure the accuracy of raw data, the Data Cloud Division of MeiCloud sets up a data quality team to monitor data acquisition, making sure that all the required data is crawled. For example, some online stores drop prices substantially for promoting, which is recognized as an outlier and missed by computers. The data quality team will check this situation and deal with it.

Big data analysis

Big data has a characteristic of value veracity. For a better use of data, IT service providers should validate the veracity of the raw data crawled from Internet, which means sorting out “the noise and the malicious information from valid, actual information” (Goes, 2014: vi).

Kepler Observatory adopts Nature Language Processing (NLP) method to segment all reviews collected, and forms a corpus of human emotions, such as very good, bad, disappointed. This corpus is used for analyzing product experience, purchase experience and after-sales experience of consumers. The accuracy rate of emotion diagnosis about customer reviews by Kepler Observatory achieves about 85%.

In addition, Kepler Observatory has manually constructed a corpus of feature words during the cooperation with different customers, which includes: keywords about online shopping and after-sales experience of different products, such as delivery speed, packaging, logistics, etc., and the others about product features, such as refrigeration and fuel consumption. The more comprehensive the corpus are, the more accurate the semantic analysis will be (Brill 1995). At present, the accuracy rate of Kepler Observatory's semantic analysis is about 80%. The data quality team monitors new keywords and emotion words and adds them into the corpus in time.

Kepler Observatory's algorithm team cleanses the collected data through data modeling, dealing with missing values and outliers. Then, the data quality team collates the cleansed data, compares them with the ones of e-commerce platforms', and calculates the error rate in order to improve the accuracy. These measures can ensure the error rate between Kepler Observatory and Tmall's data within 5%.

Valuable and replicable digital assets

Owing to the outstanding technology of data assessing and processing, Kepler Observatory owns valuable digital assets, such as databases on emotional words and industry-specific feature words, historical data of 500 product categories, 5 million online stores and 200 million products, and over 10 billion user reviews of multiple industries. These comprehensive and daily updated digital assets guarantee the accuracy and timeliness of data analysis that are basis for high quality of business decision. As Mr. Yu said,

> *Some competitors quit (big data services) after initiating one or two years because of inaccurate data. To ensure the data accuracy, companies should invest a lot of resources, such as human resources and infrastructures.*

Other than those tangible databases, Kepler Observatory forms a methodology of raw data acquisition and analysis, such as crawling framework, crawling principles and rules, data analysis principles, which provides guidance for general data acquisition and analysis. As intangible resources, this general methodology for data assessing and processing can help Kepler Observatory to provide big data services for clients in different industries rapidly.

These tangible and intangible digital assets that accumulated from 2014 and cost over 10 million RMB bring competitive advantages for Kepler Observatory because of non-substitutable and difficult-to-imitate in a short time.

Bridging Business-Data

For bridging business-data, there are two questions needed to be answered: What are requirements for a certain business? What sorts of data can satisfy those requirements? By answering these questions, we are able to establish a bridge between business requirements and data, which means using external data to address specific business needs (Mandal et al. 2014).

Bridging business-data is established on the basis of domain knowledge and managerial IT skills. After three-year deep cooperation with its parent company, Midea, Kepler Observatory categorized all kinds of businesses, built indicator and report systems, and improved them through the cooperation with its customers.

indicator systems formed based on business topics

Kepler Observatory constructs a complete set of indicator systems for different businesses topics. The business topics include e-commerce operation, public opinion monitoring, product planning, quality management, etc., covering the entire value chain of product development, production, e-commerce, after-sale and quality management.

For each business, Kepler Observatory divides its indicator systems into three levels. For example, for e-commerce business, there are primary indicators including after-sales experience, product experience and purchase experience; for the product experience, there are secondary indicators including brand reputation, product parameters, product quality, etc.; for the product quality, there are tertiary indicators such as the bad review rate. Every indicator should have a clear definition and measuring method.

Cao, a senior project manager of Kepler Observatory points out, in indicator systems, primary indicators reflect the general business needs, which are always same no matter what industries are or who the customers are, but the secondary and tertiary indicators might be adjusted according to different analysis subjects. Such an adjustment might be tiny, such as adding new indicators or modifying statistical scale.

Report systems based on business logics

Kepler Observatory also creates reporting systems based on business logic, such as BI report, brand data overview, product sale structure, etc. Report systems satisfies different requirements of top managers, middle managers and operation staff. For example, there is an overview report of bad review rate for top managers, specific bad review rate reports of certain brand, product for middle managers, and specific bad reviews for operational staff.

Report systems generate analysis reports that meet a certain business analysis requirement. Analysis reports update daily. Clients can see the previous day's sales data and reviews data two days ago. Each report consists of single or multiple indicators. For example, in the analysis report about product experience, there are indicators like the positive review rate, the bad review rate, the total number of reviews of certain product, etc., to meet the analysis requirement of product quality. The report can satisfy customers' business requirements by visualizing these indicators.

Based on general business rules and requirements, the indicator system and the report system connect data to customers' needs, providing a basis for optimizing data-driven businesses.

Standardizing Service/ Product

Kepler Observatory adopts Software-as-a-Service (SaaS) model. SaaS is an on-demand service (Benlian and Hess 2011), which refers to that service is to some extent standardized (Mäkilä et al. 2010). Since standard software products/ services are apt for most customers, they can decline operational and maintenance costs, increase the deployment speed and improve the scalability of the solution (Mäkilä et al. 2010).

Kepler Observatory realized standardization through abstracting common demands, making these demands configurable, and forming business analysis reports templates. Standardization is a process of continuous improvement, in which new common demands and analytical dimensions keep being discovered.

Configurable common business demands

Before MeiCloud was set up, Kepler Observatory serves eight major business divisions of Midea, the parent company of MeiCloud. And productization has been done on common demands. However, the business requirements and report systems of Kepler Observatory have obvious Midea's characteristics. And in cooperation with the first external customer, re-productization was done on Kepler Observatory. Some common demands were added to the report system, and indicators were manipulated into configuration, so as to meet the personalized needs of different customers. The configurable ability has been realized on the system functions of Kepler Observatory.

The report system is convenient to customize. Reports might vary a bit greatly between different customers and indicators, but because of the indicator system's relative certainty, the customization of the report system can be relatively easy. For instance, customers can modify the time span in the analysis report to their own expectations. As the product director of Kepler Observatory Mr. Yu said,

> *It would be much easier to make a report based on the indicator system; when dealing with a new business, one could easily produce a corresponding report simply by assembling several other indicators.*

Kepler Observatory can meet more than 80% of common demands. Customers can select reports and corresponding indicators according to their own concerns and needs. When involved in completely new industries, Kepler Observatory needs two months for the preparation of data base and front-end customized development and one month for trial operation. While in industries that it has been serving, it just needs one month for data preparation and front-end customized development and one month for trial operation. Fast delivery has been achieved.

Business analysis template

When dealing with new clients, the industry analysis team of Data Cloud Division will provide a brief analysis report for the client. Standardized template is formed in the brief analysis report, and routines are formed in the process of analysis. First is the stage of data acquisition. Kepler Observatory will spend 1-2 days in collecting the review data within one year of the client's product and its competitive products on JD.com and the sales data of 30 days on Tmall.com. And then the industry analysis team will use the cleaned data for market analysis, customer analysis, online store analysis and other fixed subjects, which will take 1-2 days. After the analysis, the report will be formed within one day. And then it will take another day to review and revise inside the group. The whole analysis report will be completed by one person within around one week. The efficient analysis is inseparable from the technical support and the developed business analysis template of Kepler Observatory, just as the leader of the industry analysis team Lin said,

> *Our analysis pattern is basically 80% (consistent), and our dimension is basically fixed. The 20% flexible space is for the characteristic information of some categories. For example, add some specific features of a product to the analysis. So our analysis dimension basically covers the current dimension of Kepler Observatory.*

The formation of template of business analysis report accelerates the transmission and utilization of knowledge (Jensen and Szulanski 2007). These templates are the intellectual assets of MeiCloud (Bharadwaj 2000). Even if in a completely new industry, the analysis team can quickly form insightful analysis reports to improve the likelihood of success of cooperation. As Lin said,

> *Companies usually just know their market performance situation of its own brand. However, our report is about the situation of the whole industry, and you can get a clear understanding of the market reputation and sales. This is often a report that impresses him (the customer).*

In addition to brief analysis report, the industry analysis team will also provide in-depth specific analysis of certain topics for customers, such as analyzing the reasons of drop in the sales of a product from competitors' marketing activities, marketing strategies and other perspectives, helping customers identify problems and provide solutions. Currently the in-depth specific analysis only serves the eight major business divisions of Midea. However, with the establishment of the consulting team of MeiCloud in 2018, the in-depth specific analysis will gradually open to other customers.

Product iteration

As the number of customers increases, all the project managers discuss and conclude the interdisciplinary common business demands and improve the commonality of products, such as online store assistant, digital business planning and other functions to meet the demands of online store owners. In addition, Kepler Observatory also has set up product development team, data processing team and algorithm research team to keep improving the underlying technical capabilities, such as to improve the speed and efficiency of crawler, the accuracy of natural language processing, semantic analysis, and the calculation speed of reports. Kepler Observatory will also have 1-2 regular updates every year to keep optimizing the products' functions.

Discussion and Conclusions

Through studying the case of Kepler Observatory, we find that in the big data era, IT service providers provide digital services to quite different clients in a fast pace through developing digital assets, bridging business-data and standardizing service/product (Figure 2). Specifically, business-data bridging provides guidance for accurately and rapidly accessing required data by business. Data collected and processed makes indicator systems measurable and report systems realized. Those two mechanisms tease out general business and data requirements, which can be duplicated to different industries and different clients. Through making report systems and indicator systems configurable, Kepler Observatory becomes a standardized product and can be fast delivered to different clients (Mäkilä et al. 2010), while digital assets provide data assurance on the standardization of products. The standardized product/service not only meets general business requirements, but also responds to clients' customization requirements, which improve the efficiency of delivery.

IT capabilities help to implement those mechanisms. First, IT infrastructures, such as Hadoop, Spark, and 150 servers, assure data resources accessing. Second, technical IT skills, such as NLP, crawler and algorithm improve the high quality of data processing. Third, managerial IT skills contribute to bridging business-data and developing digital assets, such as data quality team contribute to digital assets developing, operation team renew common business requirements and indicator systems.

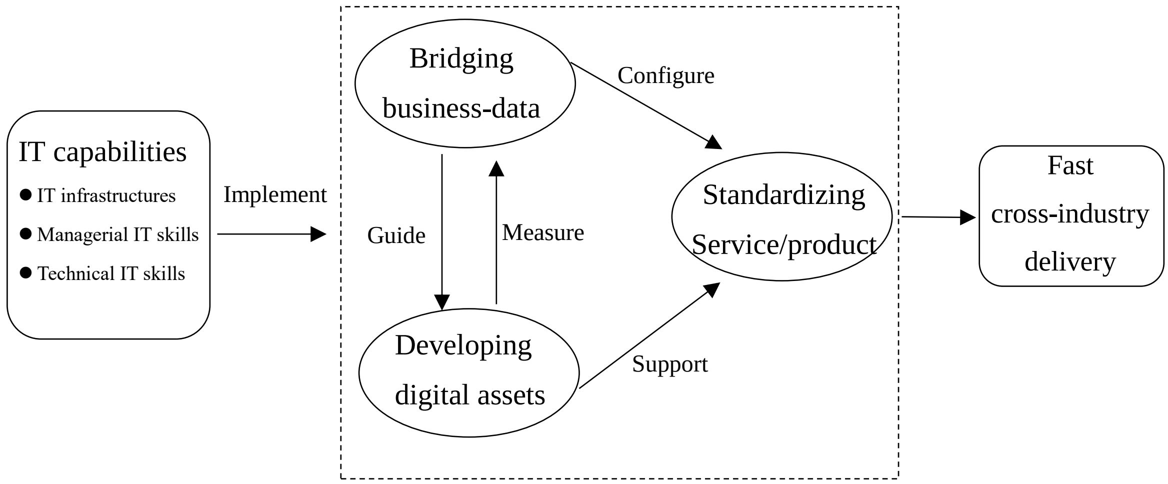

Figure 2. Mechanisms of fast cross-industry delivery of IT services

Theoretical contributions

The theoretical contributions of this research are revealed in the following two aspects: First, we answer how do IT capabilities support fast service delivery across industries to make a supplement to IT capabilities' literature. We find that IT infrastructures and technical IT skills help firms gain high quality of basic data, and managerial IT skills help shape the relationships between business and data. What's more, this study is also a new explanation of IT capabilities in new context of big data era, which extend traditional IT capabilities studies and gain new insights to future research. Second, this study emphasizes the role of IT capabilities and product from provider's perspective in fast service delivery across industries, giving a different thinking of traditional IT capabilities that IT service providers need.

Managerial implications

This research also has managerial implications. First, for IT service providers, forming indicator systems and report systems according to business topic and business logic and making them configurable can improve efficiency of delivery. Second, data quality is the key element to digital services. Big data service providers can improve the quality of data acquisition and analysis through investing IT infrastructures, IT human resources and allocating a data-quality-team.

Limitation and future directions

First, in this research, we do not discuss technologies of Kepler Observatory in detail, such as metadata management, methods of NLP and algorithms. Future research can explore the technological details on Kepler Observatory, and answer our questions from a technological view. Second, knowledge is the key asset of IT service providers, future research can investigate different impacts of domain knowledge, technological knowledge and client-specific knowledge on fast delivery of IT service providers.

Acknowledgements

This research is supported by the National Natural Science Foundation of China (Project Numbers: 71320107005 and 71702037), and Guangdong Philosophy and Social Science Planning Project (Project Number: GD15YGL04).

References

Agarwal, R., and Dhar, V. 2014. "Big Data, Data Science, and Analytics: The Opportunity and Challenge for IS Research". *Information Systems Research* (25: 3), pp. 443-448.

Bakan, I., and Sekkeli, Z. H. 2017. "Types of Information Technology Capabilities and Their Impacts on Logistics Capabilities: An Empirical Study". *Press Academia Procedia*, (4:1), pp. 54-61.

Bataineh, A. Q., Al-Abdallah, G. M., and Alhadid, A. Y. 2015. "The Role of Information Technology Capabilities in Capitalizing Market Agility in Jordanian Telecommunications Sector". *International Journal of Academic Research in Business and Social Sciences*, (5:8), pp. 90-101.

Benlian, A., and Hess, T. 2011. "Opportunities and Risks of Software-as-a-Service: Findings from a Survey of IT Executives". *Decision Support Systems* (52:1), pp. 232-246.

Bharadwaj, A. S. 2000. "A Resource-based Perspective on Information Technology Capability and Firm Performance: An Empirical Investigation". *MIS Quarterly* (24:1), pp. 169-196.

Bharadwaj, A. S., Sambamurthy, V., & Zmud, R. W. 1999. "IT Capabilities: Theoretical Perspectives and Empirical Operationalization". *In Proceedings of the 20th International Conference on Information Systems*. Charlotte, NC, USA, pp. 378-385.

Bhatt, G. D., and Grover, V. 2005. "Types of Information Technology Capabilities and Their Role in Competitive Advantage: An Empirical Study". *Journal of Management Information Systems*, (22:2), pp. 253-277.

Brill, E. 1995. "Transformation-based Error-driven Learning and Natural Language Processing: A Case Study in Part-of-Speech Tagging". *Computational Linguistics*, (21:4), pp. 543-565.

Chae, H. C., Koh, C. E., and Prybutok, V. R. 2014. "Information Technology Capability and Firm Performance: Contradictory Findings and Their Possible Causes". *MIS Quarterly*, (38:1), pp. 305-326.

Chen, H., Chiang, R. H., and Storey, V. C. 2012. "Business Intelligence and Analytics: From Big Data to Big Impact". *MIS Quarterly,* (36:4), pp. 1165-1188.

Chen, J. S., and Tsou, H. T. 2012. "Performance Effects of IT Capability, Service Process Innovation, and the Mediating Role of Customer Service". *Journal of Engineering and Technology Management,* (29:1), pp. 71-94.

Chen, Y., Wang, Y., Nevo, S., Jin, J., Wang, L., and Chow, W. S. 2014. "IT Capability and Organizational Performance: The Roles of Business Process Agility and Environmental Factors". *European Journal of Information Systems*, (23:3), pp. 326-342.

Ethiraj, S. K., Kale, P., Krishnan, M. S., and Singh, J. V. 2005. "Where do Capabilities Come from and How do They Matter? A Study in the Software Services Industry". *Strategic Management Journal*, (26:1), pp. 25-45.

Fink, L. 2011. "How do IT Capabilities Create Strategic Value? Toward Greater Integration of Insights from Reductionistic and Holistic Approaches". *European Journal of Information Systems*, (20:1), pp. 16-33.

Goes, P. B. 2014. "Big Data and IS Research", *MIS Quarterly* (38:3), pp. iii-viii.

Huang, J., Henfridsson, O., Liu, M. J., and Newell, S. 2017. "Growing on Steroids: Rapidly Scaling the User Base of Digital Ventures through Digital Innovation". *MIS Quarterly*, (41:1), pp. 301-314.

Intezari, A., and Gressel, S. 2017. "Information and Reformation in KM Systems: Big Data and Strategic Decision-Making". *Journal of Knowledge Management*, (21:1), pp. 71-91.

Jarvenpaa, S. L., and Mao, J. Y. 2008. "Operational Capabilities Development in Mediated Offshore Software Services Models". *Journal of Information Technology*, (23:1), pp. 3-17.

Jensen, R. J., and Szulanski, G. 2007. "Template Use and the Effectiveness of Knowledge Transfer". *Management Science* (53:11), pp. 1716-1730.

Levina, N., and Ross, J. W. 2003. "From the Vendor's Perspective: Exploring the Value Proposition in Information Technology Outsourcing". *MIS Quarterly*, (27:3), pp. 331-364.

Lu, Y., and K.(Ram) Ramamurthy. 2011. "Understanding the Link between Information Technology Capability and Organizational Agility: An Empirical Examination". *MIS Quarterly*, (35:4), pp. 931-954.

Mäkilä, T., Järvi, A., Rönkkö, M., and Nissilä, J. 2010. "How to Define Software-as-a-Servic: An Empirical Study of Finnish SaaS Providers". *In International Conference of Software Business*. Springer, Berlin, Heidelberg. June, pp. 115-124.

Mandal, A. K., Changder, S., Sarkar, A., and Debnath, N. C. 2014. "Architecting Software as a Service for Data Centric Cloud Applications". *International Journal of Grid and High Performance Computing* (6:1), pp. 77-92.

Olston, C., and Najork, M. 2010. "Web Crawling". *Foundations and Trends in Information Retrieval* (4:3), pp. 175-246.

Pauleen, D. J., and Wang, W. Y. 2017. "Does Big Data Mean Big Knowledge? KM Perspectives on Big Data and Analytics". *Journal of Knowledge Management*, (21:1), pp. 1-6.

Rajkumar, T. M., and Mani, R. V. S. 2001. "Offshore Software Development". *Information Systems Management*, (18:2), pp. 63-74.

Ravichandran, T., and Lertwongsatien, C. 2002. "Impact of Information Systems Resources and Capabilities on Firm Performance: A Resource-based Perspective". *In Proceedings of the 22nd International Conference of Information Systems*, Barcelona, Spain, Paper 53.

Ross, J. W., Beath, C. M., and Goodhue, D. L. 1996. "Develop Long-Term Competitiveness through IT Assets". *Sloan Management Review*, (38:1), pp. 1-31.

Santhanam, R., and Hartono, E. 2003. "Issues in Linking Information Technology Capability to Firm Performance". *MIS Quarterly*, (27:1), pp. 125-153.

Strauss, A. C., and Corbin, J. 1998. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*, London: Sage.

Stoel, M. D., and Muhanna, W. A. 2009. "IT Capabilities and Firm Performance: A Contingency Analysis of the Role of Industry and IT Capability Type". *Information & Management*, (46:3), pp. 181-189.

Tallon, P. P. 2008. "Inside the Adaptive Enterprise: An Information Technology Capabilities Perspective on Business Process Agility". *Information Technology and Management*, (9:1), pp. 21-36.

Wade, M., and Hulland, J. 2004. "The Resource-based View and Information Systems Research: Review, Extension, and Suggestions for Future Research". MIS Quarterly, (28:1), pp. 107-142.

Yoon, C. Y. 2011. "Measuring Enterprise IT Capability: A Total IT Capability Perspective". *Knowledge-based Systems*, (24:1), pp. 113-118.