Method of Building Digital Capability for Industrial Firms in the Digital Age: An Empirical Study

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Keywords: Digital capability, Sustainable advantage, Industrial firms, Digital age.

Abstract. Building digital capability in the Digital Age is important for firms to obtain sustainable advantages. This paper analyses the general framework of building digital capability of industrial firms in the Digital Age. Then based on Chinese industrial firms in China, categories and major directions of digital capabilities building are demonstrated. Furthermore, analysis is organized to illustrate the major directions of building digital capabilities in China’s three main sub-sectors.

Introduction

Building capabilities has always been the focus point of industrial firms and draws much attention from researchers in recent decades. In this paper, we discuss the firm’s capability at the strategic level [1]. The capability is an important outcome of firm’s knowledge-creating system [2] and the base of the firm’s sustainable advantage [3].

In the Digital Age, the new-generation of information and communication technologies (ICTs) brings about great changes which call for digital capabilities building based on ICTs application. In practice, promoting digital transformation needs complex procedures. Therefore, there is a pressing need for proposing a systematic method and guidance for firms to properly meet their goals. However, what is missing in existing studies is an integrated study at the strategic level, which incorporates not only technology application, but also total management optimization. To this end, this paper fills a gap in the literature by adopting the general framework announced in the standard of International Telecommunication Union (ITU), organizing empirical study on the practical evidence of building digital capability in the Digital Age and specifically illustrating the major directions and core implications of building digital capability respectively in several main sub-sectors.

Literature Review

In the context of traditional economy, Porter claims that the identification and building of capabilities in an industry should specifically consider five aspects, namely the threat of new entrants, bargaining power of suppliers, bargaining power of customers, threat of substitute products or services and the industry rivalry [4]. Joachim and Omotayo believe that the subjective initiatives of firm’s decision makers and management are critical to ensure the dynamic capabilities [5] building through well informed strategic choice.

Beside, in the context of digital age, researchers explore the influencing factors and internal mechanisms of building digital capabilities based on ICTs applications. In the beginning, attention had been paid to traditional information technologies and information systems [6-8]. Recently, the new-generation of information technologies, including cloud computing, Internet of Things, big data analysis, etc. have drawn much attention in the research field of digital capability building [9-10]. Kagermann [11] pay much attention to both Internet of Things and Data and Services in Germany, and discuss the impact, challenges and opportunities of digitalization in the perspectives of capabilities building including platform-based cooperation. Wamba et al. [12] propose a big data analytics capability model and bases on which organizes an online survey towards 297 Chinese IT
managers, from which draws the conclusion that the big data analytics capability has both direct and indirect impacts on firm’s performance.

We agree that ICT applications could bring about dynamic and digital capabilities, but existing literatures all have their own limitations in prescribe or provide guidance for firms on how to effectively build their digital capabilities in a systematic manner.

General Framework of Building Digital Capability of Industrial Firms in the Digital Age

In the late decade, based on the emerging technology evolution and management innovation, China formulates the general Framework of Building Digital Capability of industrial firms in the Digital Age (FBDC, shown in Fig. 1) in the context of Integration of Informatization and Industrialization (III). The FBDC has already been published as China’s National Standards, GT/T23000 standard series [13-15], and as international standard by International Telecommunication Union as well [3].

When building digital capability based on FBDC, firms need to focus on three important aspects. First, firms should accurately identify their digital capability in the context of Digital Age, and make proper plan of digital capability building process which can meet the demand of firms’ strategies’ realization; Second, firms should fully consider elements and their interactive relationship, including data, technology, business process, organizational structure, etc.; Third, firms should form and effectively implement systematic solutions for digital capability building, which can enable the closed-loop management & control and continuous improvement of digital capability building.

Application Practices of FBDC and Empirical Study of Digital Capability Building in China

Data Collection and Preliminary Processing

China’s National Standard, GT/T23000 standard series, has been adopted by over 13,000 industrial firms. By the end of 2018, according to the assessment carried out by third parties, over 4,000 industrial firms undertook normative process of FBDC and successfully built digital capability in the Digital Age. Based on on-line system, real-time data of firms’ applying FBDC are collected. Furthermore, structured data related to titles of digital capabilities are extracted to form a preliminary dataset, which contains over 4,100 digital capability built by the above-mentioned over 4,000 firms (It can be revealed from practice cases that each firm build one or more digital capability at the same
Moreover, aiming at sectoral analysis, according to the Global Industry Classification System (GICS) (Global Industry Classification Standard (GICS) is an industry taxonomy developed in 1999 by MSCI and Standard & Poor’s (S&P) for use by the global financial community. The GICS structure consists of 11 sectors, namely energy, materials, industries, consumer discretionary, consumer staples, health care, financials, information technology, communication services, utilities, and real estate.), we divide the above dataset into 3 subsets of firms by sectors they belong to. The 3 sectors we study in this paper are raw material sector, equipment sector and consumer goods sector.

Categories of Industrial Firms’ Digital Capabilities

This paper uses Generalised Enterprise Reference Architecture (GERA) provided in Force (2009) as the basic research framework [16], and conducts a systematic analysis based on the dataset of over 4,100 records of digital capability built by Chinese industrial firms. Results show that focus points of digital capabilities included in the dataset can be classified into 6 categories, namely digital capability respectively centered on R&D and innovation, production management and control, supply chain management, financial management and control, business management and customer service. The 6 focus points and their major directions are shown in Fig. 2.

Examples of Value Generated from Digital Capability Building

Building digital capability centered on R&D and innovation has two significant values: i) for the firms who have achieved automatic data transfer between processes of product design and manufacturing, the average proportion of products using digital R&D and design tools are 20.0%
more than the other firms; ii) compared with other firms, firms building this kind of digital capability are 7.1% more in the average success rate of new product development, and 32.6% less in the average time duration of new product development cycle.

Building digital capability centered on production management and control also has two significant values: i) compared to other firms, firms building this digital capability are 12.9% less in the average duration of production cycle, and 95.1% more in the average first-time qualification rate of products; ii) compared with other firms, firms building this digital capability are 2.1% and 2.3% more respectively in the average equipment utilization rate and average utilization rate of production capacity.

Building digital capability centered on customer service enables firms improving in two aspects. They are 1.5% less in terms of average duration of order delivery cycle, and 3.6% more on the average satisfaction rate of customer service than other firms.

**Major Directions of Digital Capability Building in Typical Sectors**

**Major Directions of Digital Capability Building in Raw Materials Sector**

Chinese firms in raw materials sector promote elaborated management at strategic level, to achieve cost reduction and efficiency. Statistical results show that, when building digital capability, these firms mainly focus on production management and control, financial management and control, as well as business management and control. Within the scope of the above three categories, we further analyze the proportion of firms in each major direction, as shown in Fig. 3.

![Figure 3. Major directions of digital capability building of firms in raw materials sector.](image)

**Major Directions of Digital Capability Building in Equipment Sector**

The new generation of ICTs provides favourable opportunities for Chinese firms in equipment sector to provide customer with more premium, intelligent and differentiated products than others at the strategic level. Statistical results show that, when building digital capability, these firms mainly focus
on R&D and innovation, production management and control, and customer service. Within the scope of the above three categories, we further analyze the proportion of firms in each major direction, as shown in Fig. 4.

**Major Directions of Digital Capability Building in Consumer Goods Sector**

The ultimate goal for firms in consumer goods sector of China is providing users with experience beyond their expectation. In order to achieve this, firms mainly focus on building digital capability centered on consumer service and supply chain management. Within the scope of the above two categories, we further analyze the proportion of firms in each major direction, as shown in Fig. 5.
Conclusion

This paper adopts FBDC published both in China’s national standard and international standard of ITU, and based on which organizes and empirical study to illustrate the major directions and general interests of industrial firms’ building digital capabilities in the Digital Age. On one hand, this study promotes the progress of researches on digital capability building and sustainable advantage obtaining through theoretical extension of FBDC. On the other hand, the results are referable for practitioners to effectively construct a pool of potential digital capability and make tactical decisions on the identification of needed sustainable advantage. Also, it would provide guidance to practitioners on how to improve the efficiency of building their digital capabilities.

Acknowledgement

This research is supported by two funding, one is “Evaluation Theory and Method towards Large Data Attribution Analysis” (61771281) supported by National Natural Science Foundation of China and the other one is “Research on System Path and Method of Integration Strategy of Industrialization and Informatization” (15ZDB151) supported by National Social Science Foundation Fund of China.

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