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A STRUCTURE FOR ADVANCE DECISION MAKING IN THE INTERNET ERA

[1]Agbor, Stephen and **[2]Olley, Omatsola Divine**

[1]Department of Business Administration and Management, Delta State Polytechnic, Ogwashi Uku

[2]Department of Public Administration, Delta State Polytechnic, Ogwashi Uku

Abstract

This paper aims to advance our understanding of innovation decision making among organizations in the Internet era. By identifying an asymmetry existing between outward driving forces and inward shaping forces of innovation, it develops a structure for integrating the two driving forces and supporting advance decision making in the changing world. By means of incorporating the changes of advance environment, advance practices and innovation paradigm, the structure provides us with a useful tool for dealing with advance issues in a networked business atmosphere.

Keywords: *Advanced Decision Making, Internet Era, Innovation*

INTRODUCTION

Innovation is a key feature in the Internet Era, whether in the dot-com heydays or after the dot-com meltdown (Loudon, 2001, Chesbrough, 2003). To make appropriate decisions on innovation has been proved to be crucial for an enterprise to compete successfully in the new business environment (Christensen, 1997; Spector, 2001), since businesses constantly seek to find new products or services, efficient processes to manufacture or provide these products or services, and innovative ways to sell these products or services.

However, a theoretical asymmetry exists at the current stage. We have quite a clear idea about how innovation has been playing an important role in forging the internet era. But we do not have a satisfactory picture of how innovation itself has been or is being transformed in the internet era (Lan, 2004). In other words, we have experienced the outward driving forces of innovation, but we have not paid enough attention to the inward driving forces which are shaping or reshaping innovation. Given this asymmetry, scholars suggest that we should update our understanding of innovation, and be innovative in the area of innovation itself (Brown, 2003). Otherwise, we may run the risk of being buried in applications of innovation without a clear picture about the dynamics of innovation (Chesbrough, 2003).

To deal with the asymmetry, this paper introduces a structure for supporting advance decision making. In the exploration, it uses a platform-dependent approach, in which innovation development is treated as a two-way street. While inventions and innovations create or transform a production platform – the synergy of a set of enabled technologies, their major applications and special requirements for organising and structuring related activities (Schumpeter, 1939; Rosenberg, 1982; Shapiro and Varian,

1999; Enriquez and Goldberg, 2019), the new production platform stimulates more inventions and innovations, and also changes the ways for so doing (Schmookler, 1966; Enriquez, 2001; Hargadon and Sutton, 2019; Thomke, 2001). By taking the platform-dependent view, advance development resembles a spiral (Ray, 1984; Faber and Proops, 1990). It keeps consolidating the inward shaping forces and outward driving forces. Innovation decision making, therefore, has to consider both task-oriented specifications, and platform-oriented generalisation. While the former focuses on the special requirements for a given innovation job, the latter focuses on the pervasive fashion of conducting an innovation.

This paper is mainly a theoretical discussion. By adopting the above platform-dependent approach, it is organised into the following sections. After this introduction, Section 2 briefly reviews literature on fundamentals of innovation decision making, particularly on innovation structure. Section 3 analyses the features of the current production platform – the digital platform in the internet era. Section 4 presents a structure for integrating outward driving forces and inward shaping forces of an innovation. The final section discusses the applications of the structure in supporting innovation decision making.

LITERATURE REVIEW

To make any decision related to innovation, the very basic issue to be considered by an organisation is to understand what kind innovation it is dealing with. Different types of innovation have different acquisition channels, different realization paths, and different integration requirements and consequences. Given the central role of understanding innovation, identifying the types of innovation has been a key component in the existing literature. However, among the various discussions about the types of innovation, most of them use a dichotomy structure in a discrete fashion.

Since Schumpeter (1939) made the first dichotomous division of innovation i.e., radical innovation and incremental innovation, several dichotomous structures have been developed. Among them, product vs. process innovation (Abernathy and Utterback, 1978), architectural vs. modular innovation (Henderson and Clark, 1990),

Radical and incremental division originated from the interface of business and innovation. It reflects the different impacts of innovation on business and the different knowledge foundation deployed. An incremental innovation builds squarely on the established knowledge base. It steadily improves the methods or materials used to achieve an operational goal. Incremental innovation introduces relatively minor changes to the existing product, exploits the potential of the established design and often reinforces the dominance of established firms. Although it draws from no dramatically new science, it often calls for considerable skills and ingenuity, and over time has very significant economic consequences (Henderson and Clark, 1990). A radical innovation involves methods and materials that are novel to the innovator and others (Schumpeter, 1939). The novel methods and materials are derived from either an entirely different knowledge base or from a recombination of parts of an established knowledge base with a new stream of knowledge. It is based on a different set of engineering and scientific principles and often opens up whole new markets and potential applications (Schmookler, 1966; Methe, 1991).

Technology and business innovation division results from the identification of different targets or fields an innovation can apply to, as well as the differences between innovators in their career path and their mindsets. Technology innovation focuses on technical feasibilities and putting these feasibilities to new uses. Technology innovations are

usually conducted by people with technical training, through systematic research, development and engineering activities. Technology innovations involve both product and process innovation and continuously change the link between innovators and their environment. This nature enables technology innovation to become the dominant issue in managing worldwide competitiveness (Roberts, 2012). In contrast to technology innovation, business innovation focuses on changing the link between an enterprise and a value chain or a value net that it is locked in, the structure of an organisation, the market segments an enterprise is aiming at, and the method of doing business. Within the domain of business innovation, strategic innovation (Markides, 2017), market innovation (Leonard-Barton, 2014) and value innovation are often used to display changes without technology innovation (Markides, 2019; Kim and Mauborgne, 2019). Differing from technology innovation, business innovation can be conducted by anyone in a society with entrepreneurial spirit (Schumpeter, 2021). They bring in new knowledge, help people see old concepts in new ways, or help a company break from its past.

It is apparent that previous studies on the types of innovation activities expand our knowledge on innovation. However, they also display problems. The prominent ones are that the linkage between different parts is missing and the progress of innovation is difficult to fit into the basic innovation structure. Given these barriers, our understanding of the dynamics of innovation does not progress very well. As pointed out by Brown (2003), our understanding of innovation is stale, and innovating innovation is needed.

THE CURRENT PRODUCTION PLATFORM: DIGITAL PLATFORM

In order to link various dichotomy structures in the existing literature with the internet era, this section introduces the concept of the digital platform. A production platform is defined here as a stage for human beings to conduct major production and related activities in a certain period. For each production platform, three dimensions can be used to measure its uniqueness: unique technological foundation, special users, and specific stimuli to other activities. The interaction of the three dimensions makes production platforms differ from each other. The current production platform, i.e., the digital platform shows its own features in the all three dimensions.

The technological foundation of the digital platform consists of three sets of technologies: digitising technology, networking technology, and authoring technology. Digitising technology is a collection of information processing tools and techniques. It originated from the development of computers and extended to software engineering and digital information handling (Lan, 2004). The development of digitising technology increases computing power, or offers possibilities for shifting business operations from a materials-based to an information-based platform (Shapiro and Varian, 2006). Analogous to the manufacturing industry for the industrial era, digitising technology produces final products from raw materials – data, information and knowledge. Networking technologies result from the convergence of telecommunication technology and electronic technology. They enable information exchange to enjoy unimaginable freedom, judged by bandwidth, connectivity, accessibility, and diversity. This freedom is based on universal protocols for information exchange, and a layered operating structure (Kalakota and Robinson, 2001). Analogous to the role of transportation in the industrial revolution, networking technology links different components of the information world in a cost effective and functional way. Authoring technology is a collection of various tools and techniques associated with the development of the internet, particularly the World Wide Web. The development of authoring technologies provides solutions for changing interactions between an

organisation and its stakeholders by adding a virtual dimension, so that mass creation and decoupling of the front-end and back-end of an operation can be realised. These technologies determine either the capacity of the platform or the way in which it is functioning. Authoring technology can be seen as the part of digitising technology that is specialised in building online operations. It produces various tools for dealing with text, graphics, sounds and visual content. Analogous to the construction industry in the industry society, authoring technology provides foundation for building up various interfaces, places and media, among people and machines and between people and machines. The coexistence and coevolution of the above three sets of technologies make the production paradigm in an information society dramatically different from that in an industry society.

There are boundless applications resulting from these technologies and their unique capacity to handle information, convert processes, link different components, and build up virtual interaction spaces. This user as consist of a spectrum of applications. Within the spectrum, three applications are pervasive: digital messaging, digital transactions and digital integration. Digital messaging is mainly reflected in accelerating information flows through the internet. It facilitates generation, distribution, storage, sorting and consumption of message by using the digital platform (Shapiro and Varian, 2019). One direct role of digital messaging is to reduce the existing asymmetry of information between buyers and sellers, regardless that the asymmetry is searching oriented or bargaining oriented (Eisenmann, 2012). Another role is to improve the efficiency of coordinating activities and reduce operation costs. The third role is to change peoples' behavior towards information and decouple many traditionally bounded activities (Sawhney, 2021). Digital transaction is characterized by electronic payments and related information flows. It involves financial institutions and countless businesses and individuals. The simplicity of the application either diminishes the spatial and temporal gaps in conducting transactions, or intensifies the battle for securing the transaction channel. Digital integration is reflected in structuring and restructuring activities, functions, and organisations, which happen at different levels. It glues traditional separated parts, or combines traditional irrelevant components in a meaningful way (Lan, 2014). The vertical integration shows the change of linkage along a value chain (Afuah, 2013). The horizontal integration shows the convergence of traditionally separated activities, such as cultural activities and commercial activities.

While the digital platform is formed by absorbing innovations, it also emits its influence. The third dimension shows these stimuli for facilitating changes, including virtuality (being a virtual state), intelligence and interconnectivity. Virtuality results from the digitisation of activities and processes, and it follows a different set of rules in creation, exchange, delivery and consumption of products and services. It breaks or reduces the limitations of the physical world, and gives human beings a new 'development' dimension (Shapiro and Varian, 1999). Intelligence means that the operations of many activities can be conducted in a distributed, synchronised or flexible way through capturing, retrieving, conveying, creating, processing, and distributing information (Sawhney, 2001). In contrast to static, low level and inflexible interaction between systems or subsystems, intelligence is rooted in the mass creation of knowledge, digitisation of processes and easy recombination of activities at both mass and individual levels (Sawhney, 2001). Interconnectivity breaks isolation and separation. It increases the intensity of exchange. Horizontal interconnectivity shrinks geographical distance. Vertical interconnectivity changes either the boundaries of the linkage, or the pattern of the linkage. It makes a connection that is organic or flexible (Afuah, 2003).

AN INTEGRATED STRUCTURE FOR ADVANCE DECISION MAKING

Innovation among a development cycle

By linking the previous two sections, this section presents an integrated innovation structure as shown in Figure 1. Considering innovation in a business setting, innovations drive the changes of a production platform. At the same time, they are affected by the emerging production platform. The interaction between innovation and the production platform forms a development cycle.

First, innovation activities show a strong 'push' role. The aggregation of innovative results, particularly the key innovation results, helps modify or create a production platform (Rosenberg, 2012).

Secondly, the production platform is not a passive absorber of innovations. It is also an active object with strong radioactivity, which can affect any activity occurring in its field. The reason for this active role comes from the different mechanism of a product platform for filtering and synchronising various signals (Sawhney, 2021). It also results from the different incentives and limitations to innovators offered by different production platforms (Oliver, 2010). These impacts are shown as 'market selection', which pull business activities to a certain destination by using certain methods (Schmookler, 2016; Enriquez and Goldberg, 2010).

Thirdly, innovation activities show 'dualism' just like other business activities: they are subject to market selection and have to compete for survival. While other business practices change along with the new production platform, innovation practices also change (Sylvester and Klotz, 1983; Hargadon and Sutton, 2019). The continuous interaction between market selection and survival competition forges a new innovation paradigm, in which the innovation community shares new beliefs, values, and techniques. Therefore, the innovation paradigm restructures itself by consolidating various changes in its components (Lan, 2014).

Fourthly, the drive for increasing innovativeness requires an organisation to integrate its innovation activities and other activities in an innovative way. It also requires an organisation to improve its innovation management through learning by doing (Chesbrough, 2003). The requirements are coordinated with the two roles of innovation management: increasing innovation's importance as a driving force for business development, and improving efficiency in conducting innovations (Brown, 2012, 2003).

Changes of innovation environment and innovation practices

Given the stimuli of the digital platform, the innovation environment has changed in the internet era. The foci of the environment change are the linkages between different components. One is that the coexistence can be 'virtual'. It means that physical distance is losing its importance (Sawhney and Prandelli, 2019). The other is that linkage among entities is experiencing a shift from a closed fashion to an open one (Fingar et al., 2019, Chesbrough, 2003). The closed fashion is governed by a view that successful innovation requires control. Companies must generate their own ideas, and then develop, market, distribute, service, finance, and support them on their own. The open innovation environment is characterised by active usage of external knowledge (Sawhney and Prandelli, 2019; Robert and Liu, 2001; Von Hippel, 2001), the engagement of venture capital (Christensen, 2016; Chesbrough, 2003), unbundling of innovation chain (Quinn et al., 2014; Chesbrough, 2003), and focusing more on building a better business model (Christensen, 2017; Chesbrough and Rosenbloom, 2012). If the innovation environment demonstrates

market selection criteria, innovation practices display the responses of organisations for survival competition. Innovation practices are widely spread in a spectrum ranging from generating innovations to conducting, delivering and realising them.

There are two ways for an enterprise to have an innovation: developing it or licensing it. When an organisation chooses a purchasing path, accessing key expertise and complementary assets are key considerations, and outsourcing and alliances are widely used. It has been documented that the top 500 global businesses have an average of 60 major strategic alliances each (Roberts and Liu, 2001); and there is a high correlation throughout the industry between a company's degree of outsourcing, its innovativeness, and its product margins and return on investment. In practicing outsourcing and alliances, two types of leverage are getting popular. One is bonded leverage, in which the tight management of relations with partners is required. The close integration could cut costs, speed up cycles, and improve quality. But it also requires resources, the attention of management, lengthy negotiations, detailed contracts, and the extensive monitoring of performance (Quinn, 2019; Roberts and Liu, 2001; Brown, 2012). The other is non-bonded leverage, in which loosely coupled processes are the building blocks of networked companies. Since non-bonded leverage focuses on 'process orchestrators' instead of structure and monitoring, it can have many partners (Brown, 2012).

When an organisation chooses a developing path, creating a cluster of products or service is a tradition. However, this tradition is expanding from a narrow sense to a broad one. The narrow sense of the product family focuses on technology and design, particularly, the development and sharing of key components and assets within a common platform. The broad sense of the product family involves a deep understanding of the target customer's need for the product, how they will use it, and how the customers will integrate the product within their technical and business infrastructure (Meyer and Utterback, 1993; Von Hippel, 2001). By sharing components and production processes across a platform of products, companies can develop differentiated products efficiently, increase the flexibility and responsiveness of their manufacturing processes, and take market share away from competitors who develop only one product at a time. These efforts can also achieve successful mass customisation.

Using software has become a universal reality in almost every industry and activity without exception to innovation. Using software in innovation not only increases the efficiency of innovative activities, but also changes the organisation of these activities. In process innovations, software is the core element for increasing automation and flexibility. In product innovations, software creates the functionalities that make products valuable to customers. In other cases, software is the product or service that the customer actually receives (Quinn et al., 2016). The wide use of collaboration software goes together with the restructuring of the innovation processes. The latest tools, which come from a new generation of companies, are easier to use and customise. Therefore, it is software instead of new team concepts or personal management models that is responsible for most of the increased speed and precision of today's innovation processes (Quinn, 2019). However, because most business activities and processes are embedded in software, they become replicable. This contributes to the rapid erosion of the strategic advantages possessed by the developers of innovation.

Features of the new innovation paradigm

Drawn on the changes of innovation environment and practices, a shift of the innovation paradigm can be spotted: the traditional discrete paradigm is being replaced by an emerging integrated paradigm. Under the umbrella, all three components of the innovation paradigm display their own transformations: among components is shifting from a closed fashion to an open one; innovation practices are shifting from a physical-media to digital-media orientation; the basic structure of innovation is shifting from dichotomous divisions to a unified consolidation.

The traditional discrete innovation paradigm is corresponding to an industrial production platform. Within the paradigm, the basic understanding and agreeable expression is the discrete innovation structure, which is reflected in various dichotomous innovation divisions. The competitive environment encourages inward-oriented beliefs and behaviour, which are testified to by isolated or closed operations. The innovation practices fall in the domain of pursuing the silo model, using physical outlets and lacking transformable toolkits.

The emerging integrated paradigm is corresponding to the current digital production platform and displays great integration. Within the paradigm, integration can be seen from each component. Firstly, the basic understanding and agreeable expression is a consolidated innovation structure, which could be reflected in using the common infrastructure to bridge various innovation activities and constitute a life cycle. Secondly, the competitive environment encourages networked attitudes and behavior of innovators. Thirdly, the innovation practices are greatly reshaped by the virtuality: pursuing digital outlets, seeking distributed delivery and developing and deploying digital toolkits.

Among the three components of the emerging innovation paradigm, integration is meaningful at three levels: function integration, process integration and capacity integration. Function integration breaks the separation between technology and business innovations with emphasis on creating an innovative entity. Process integration breaks the boundaries of organisation and units with an emphasis on increasing innovativeness. Capacity integration breaks the limitations imposed on individuals such as working and hobbies, career related and non-career related, inside an organisation and outside it, with an emphasis on forming an innovation landscape. The collective changes of innovation on the digital platform are expected to lead a shift of entire constellations of beliefs, values, and techniques shared by the innovation community.

DISCUSSION AND CONCLUSION

Information and communication technology is a critical resource and a strategic tool for improving today's business decision making. Proliferation of new technologies especially internet creates a business environment filled with opportunities and challenges. It is true for innovation management. However, the opportunities and challenges are not raised randomly. They have their triggers and show a certain pattern. In this paper I presented a structure for linking innovation with business development and highlighted the features of the current innovation paradigm.

Firstly, innovation management should focus on providing a 'solution' instead of a 'product' by combining task-oriented specifications and platform-oriented generalisation. For any give task of innovation, it must have certain uniqueness in its focus and coverage. However, the networked environment also determines that many issues and their handling are interrelated. In coping with this convergence, organisations have to pursue a solution-

providing strategy instead of a product-providing strategy. Solution-providing' strategy means that the companies can wrap a problem or task-oriented specifications by changing functionalities, which can be made through embedding their innovation into software, and integrating various innovation efforts. In this way the companies can generate different solutions for different problems, which will dramatically increase the efficiency of innovation and the competitiveness of the companies. This method can be widely used in any problems which can have an entire or partial digital solution.

Secondly, innovation activities can be better integrated with other activities. According to the integrated innovation structure, innovation is no longer a supporting function which can be separated from other functional areas and remain limited to certain units, certain people, and certain jobs within an organisation. Innovation is a shared commitment for generating useful new products and useful solutions. It is integration, and not isolation that plays a more important role in the Internet Era.

Thirdly, the integration can be meaningful at three levels for an organisation: function integration, process integration and capacity integration. Function integration means breaking the separation between technology and business innovations with an emphasis on creating an innovative entity. Process integration means breaking the boundaries of an organisation and units with an emphasis on increasing innovativeness. Capacity integration means breaking the limitations imposed on individuals such as work and hobbies, career related and non-career related, inside an organisation and outside an organisation, with an emphasis on forming an innovation landscape. Given an understanding of the innovation structure, organisations can pursue their innovative integration for innovation. For example, IBM has chosen the engaging model to combine business and technology innovation. Google has experimented with the free-selection model to encourage developers to combine their jobs and their hobbies within a working setting. The most important factor for an organisation is to adjust its mind-set according to the innovation paradigm concept.

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