

# FinTech banking industry: a systemic approach

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## Abstract

**Purpose** – This paper aims to explore FinTech and its dynamic transitions in the banking industry. In particular, the study analyses the systemic innovation nature of FinTech-based innovations. The main contribution of this research study is the development of systemic innovation model which can be used as a dynamic tool to track the progress and pattern of technology development and diffusion. The research also discusses the latest financial innovation of PromptPay FinTech – the e-payment system in Thailand.

**Design/methodology/approach** – This research uses the case study approach to analyse the systemic innovation characteristics of FinTech-based innovations. This research offers a new systemic innovation model which is developed and can be used as a dynamic tool to track the progress and pattern of technology development and diffusion. The study uses FinTech-based innovations as case study samples to gain a better understanding concerning the systemic characteristics and the pattern of technology diffusion under the analytical framework of systemic innovation model. This research involves qualitative interviews with five major commercial banks in the financial services industry of Thailand.

**Findings** – The analyses of findings show the systemic characteristics of FinTech-based innovations in the banking industry, both at a global scale and Thailand case. The analyses have shown that systemic characteristics of the innovation process are the outcome of interactions between the complexity of the innovation and the capabilities of innovators in managing the innovation. The insightful implications on the systemic nature of innovation give the trend and direction of FinTech-based innovation development in the banking industry.

**Originality/value** – The main contribution which shows originality and value of this paper is the development of systemic innovation model. This research study develops a systemic innovation model to analyse the systemic characteristics which can be applied to all innovations in any industry. The model can also help track the progress and pattern of technology development and diffusion. Therefore, the model can be used to project the trend and diffusion of innovation competition in the banking industry.

**Keywords** Innovation, Banking, Economic forecasting, Strategy

**Paper type** Research paper

## 1. Introduction

This paper applies the concept of Rogers's innovation diffusion theory (Rogers, 1983, 1995, 2003) to analyse the dynamics of the banking industry. Rogers's innovation diffusion theory (Rogers, 1983) has influenced the concepts of technological change, and a number of scholars have later expanded the concepts based on his works. Nevertheless, one of the shortcomings of the innovation diffusion theory has been the dimension of systemic characteristics and the extent to which the systemic nature influences the trend on the diffusion of innovation. (The concept of systemic innovation in this paper refers to the multi-party interdependence in the development process of innovation. Please see further discussions on the concept of systemic innovation in Section 2.2). In particular, this study will analyse the diffusion of financial technology or FinTech in the banking industry.

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The financial technology (or FinTech) is seen as one of the technologies that would revolutionise the banking industry. FinTech has received global attention as the challenging technology that would empower firms to compete effectively in the twenty-first century. Governments around the world have paid attention to this challenge and devised policies and regulations to support FinTech development. Figure 1 depicts the global venture investments in FinTech companies from 2010 to 2016. The global venture investments show a significant increase above US\$12bn since 2015. The total venture investments in the global FinTech market in the year 2016 are US\$13.6bn (KPMG, 2017).

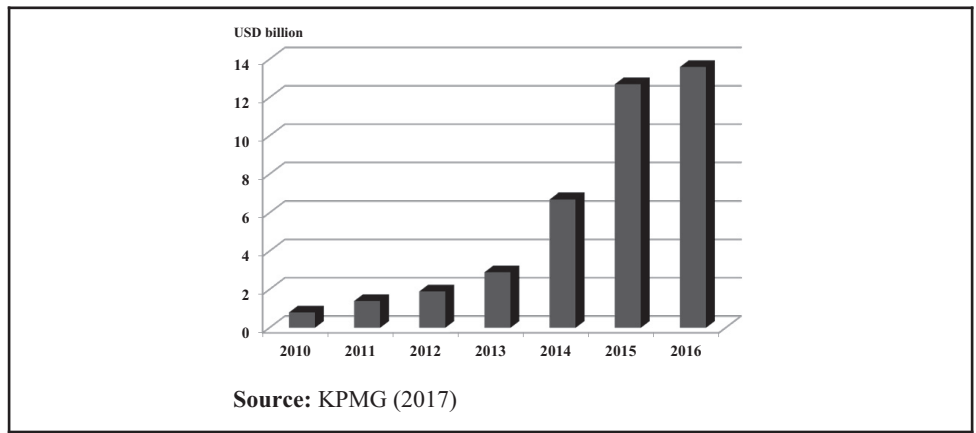
For many decades, banks invest heavily in technology in attempts to improve the efficiency of the financial innovation system. The banking landscape has witnessed the development of various FinTech-based innovations like electronic fund transfer at the point-of-sale (EFTPOS), automated teller machine (ATM cash dispenser), internet banking, Society for Worldwide Interbank Financial Telecommunication (or SWIFT) international electronic fund transfer, Electronic Data Interchange (EDI), mobile banking, Bitcoin wallet, Blockchain banking, crowd funding. The objective of this research study is to understand the diffusion process of financial technology or FinTech in the financial services industry. In particular, the study explores the systemic characteristics underlying FinTech-based innovations in the banking industry. The research aims to highlight the extent to which these systemic characteristics would influence the collaborative network solutions and the level of technology diffusion.

The objectives of this research in studying the diffusion of financial technology or FinTech in the banking industry are as follows:

- *Theoretically:* It will examine how the systemic characteristics of an innovation relates to the difficulty or complexity of innovations and to the capabilities of innovators.
- *Practically:* It offers the systemic innovation model to track the progress and pattern of technology diffusion.

The structure of this paper is organised as follows. Following the introductory section, this paper has four further sections. Section 2 reviews the theoretical literature on innovation, financial innovation, systemic innovation and technology diffusion process. Section 3 explains the methodological framework. This research offers a new methodological framework of systemic innovation model to analyse the progress and pattern of technology diffusion. Section 4 presents the empirical findings on the diffusion of FinTech-based innovations in the banking industry. The latest initiative of PromptPay FinTech in Thailand’s banking landscape is also discussed. Research implications and conclusions are drawn in Section 5.

**Figure 1** The growth of venture investments in the global FinTech market



## 2. Theoretical framework

### 2.1 Innovation and financial innovation

Innovation is a complex process whereby many scholars have developed several approaches to define its nature. In the context of technology management, the term "innovation" is defined in several ways. The definition encompasses a process of enhancing existing technology (Rosenberg, 1976, 1982; Nelson and Winter, 1977, 1982; Dosi, 1982) or a process of turning opportunities into practical use (Pavitt, 1984; Tidd and Bessant, 2009). In a more comprehensive approach, innovation is defined as an integrated process of enhancing the technology frontier, transforming this into the best commercial opportunities and delivering the commercialised product/process innovation in a competitive market with widespread use (Schott, 1981; Daft, 1982; Rothwell and Gardiner, 1985).

The banking sector is regarded as a service sector – a tertiary sector where the industries involve the transformation of material goods, people, or information (Freeman, 1991; Miles, 1993, 1994, 2003, 2005; Utterback, 1994; Voss, 1994). The financial services industry, specifically banking, is seen as the vanguard sector in the use (not the creation) of information technology (IT) (Barras, 1986, 1990). In recent years, the financial technology (or FinTech) is seen as one of the technologies that would revolutionise the financial services industry. The term "FinTech" encompasses technology-enabled services and solutions with the use of integrated IT. FinTech payment innovations offer new landscape in the digital era of financial industry. FinTech also provides a platform for banks and non-banks to facilitate cross-network transfers and payment services (Thompson, 2017; Shim and Shin, 2017).

### 2.2 Systemic innovation

Systemic innovation is a type of innovation which requires a number of complementary systems to realise the value of innovations. Systemic innovation involves information interchange and coordination through a linked system (Chesbrough and Teece, 1996). The concept of systemic innovation emphasises coordination in terms of the standard setting for an innovation, for example, mobile phones and personal computers (PCs). An allied concept of integration by Lawrence and Lorsch (1986) concerns the required integration amongst different units in an organisation. However, the concept is rather more to do with solving complexity and uncertainty problems in an organisation, for example, in the production and delivery process.

The concept of systemic innovation refers to a set of interconnected innovations whereby an innovative coalition is necessary to achieve market acceptance. In other words, the systemic innovation is one where the benefits of an innovation increase disproportionately with the use and diffusion of the innovation amongst users and where most of the benefits are external to the particular innovator of the product or process and accrue to a wide range of users and uses (Chesbrough and Teece, 1996; Chesbrough, 2003a, 2003b, 2011; West *et al.*, 2014; Appleyard and Chesbrough, 2017). In this study, the concept of systemic innovation will build upon these prior studies and would help fill the gap in systemic financial innovations (Please see Section 3).

### 2.3 Technology diffusion process

In the innovation studies literature, Rogers used well-established theories in sociology, psychology and communications to develop an approach to study the diffusion of innovations (Rogers, 1983, 1995, 2003). According to the study by Rogers (1983, 1995, 2003), the innovation development process comprises six stages: problem definition, research (basic and applied), development, commercialisation, adoption and diffusion and consequences. Some of the pioneering works in the area innovation diffusion also include

the concept of technology acceptance (Davis, 1989; Venkatesh and Davis, 2000; Venkatesh *et al.*, 2003). The technology acceptance model (TAM) developed by Davis (1989) is the most widely known theoretical framework explaining the process of technology adoption and diffusion. According to the TAM Model, the main factors influencing user adoption in the marketplace are:

- perceived ease of use (PEOU). The degree to which a person believes that using a particular system would be free from effort; and
- perceived usefulness (PU). The degree to which a person believes that using a particular system would enhance his or her job performance;

TAM, based on the theory of reasoned action (TRA), has also been used to understand and predict the users' acceptance of particular technologies. From the technology management perspective, the model can be used to understand consumer behaviour, target market and help predict usage across different fields of technology-based innovations. The unified theory and acceptance and use of technology (UTAUT) model is another important model that was developed and based on the TAM Model. UTAUT describes additional key constructs determining the behavioural intention: performance expectancy, effort expectancy, social influence and facilitating conditions (Venkatesh and Davis, 2000; Venkatesh *et al.*, 2003; Wang and Wang, 2010).

The diffusion theory often deals with the innovation process. The innovation process characteristically exhibits an S pattern. Schumpeter's long-wave theory explains the waves of economic development whereby the shift from existing business cycle to new one leads to the growth of industrialisations. The Schumpeterian view of creative destruction emphasizes discontinuity of economic development. That is to say, the process of creative destruction brings about the economic growth of which the emergence of new product/process innovations does not grow out of the old ones but eliminates them (Schumpeter, 1939, 1967).

Table I summarises the various concepts of the technology diffusion process. Utterback and Abernathy (1975) articulate the innovation process as an S pattern. Vernon (1966)'s product life cycle (PLC) is a classical model explaining the development as a pattern of product substitution (the S-curve pattern). The phases along the PLC reflect innovation diffusion – the progress of product/process innovations along the stages of introduction,

**Table I** Principal concepts of the technology diffusion process

<i>Scholars</i>	<i>Principal concepts of innovation diffusion</i>
Utterback and Abernathy (1975)	The life cycle explains sources and directions of technological change. The life cycle explains the development of technology-related products and processes
Fisher and Pry (1971)	Fisher and Pry offer a classical model for forecasting innovation diffusion. Their study is focused on the diffusion process of product innovations and the substitution rate of technological change
Gort and Klepper (1982)	The study measures and analyses diffusion of product innovations. Their study divides the life cycle of the new product industries into five stages. The study provides a basis for the development of a theory of the evolution of industries
Abernathy <i>et al.</i> (1983)	They view the innovation process as a process of industrial de-maturity. They argue, from the perspective of evolutionary theory on economic development, that technological change may alter the character of innovation and competition and over time affect the structure of the industry
Peres <i>et al.</i> (2010)	They study the diffusion processes of new products and services. They view the innovation diffusion as a process of market penetration whereby the launch of new products and services is driven by social influences
Guseo and Guidolin (2015)	Their study is focused on the innovation diffusion—the new PLC. They propose a multimodal model to the life cycle of the compact cassette format for pre-recorded music in Italy

Source: The author's design

growth, maturity and decline. Given the competitive environment of the innovation/diffusion process in the industry, Utterback and Abernathy (1975) developed a model of the dynamics of innovation – the innovation life cycle model to describe the process of innovation and the degree of technological change. The innovation life cycle also provides a basis for technological forecasting. According to the study of the innovation process by Fisher and Pry (1971), they argued that, when a new innovation reaches about 5 per cent penetration of the potential application market, it provides a reasonable base for forecasting the speed and ultimate penetration achievable.

### 3. Research methodology

There is a wealth of literature on the innovation system (Lundvall, 1992, 1998, 1999, 2003; Patel and Pavitt, 1994; Niosi and Bellon, 1995; Lee and von Tunzelmann, 2005; Carlsson, 2006; Fagerberg and Srholec, 2008). However, to date, only limited research has been carried out to explore the financial innovation system with respect to the systemic characteristics. Therefore, it seems reasonable to carry out the research with particular focus on FinTech-based innovations in the banking industry.

Concerning the main contribution of this paper, this research study develops a systemic innovation model to analyse the systemic characteristics. The model can also help track the progress and pattern of technology development and diffusion. The concept of systemic innovation in this study is built upon the existing literature and refers to the innovations that require multi-party interdependence in the development process of innovation. The term also involves the importance of network externalities. The innovation with high systemic nature is an innovation where the benefits increase disproportionately with the use and diffusion of the innovation amongst users. Most of the benefits are external to any potential innovator of the product or process and accrue to a wide range of users and uses.

This research uses the case study approach, as it seems most appropriate to examine the interaction of factors and events involving a large number of actors (Eisenhardt, 1989; Yin, 2013). In particular, the study uses FinTech-based innovations as case study samples to gain a better understanding concerning the systemic characteristics and the pattern of technology diffusion under the analytical framework of systemic innovation model. The research also discusses the latest financial innovation of PromptPay FinTech – the e-payment system in Thailand. To understand the diffusion of PromptPay FinTech, this research involves qualitative interviews with five major commercial banks in the financial services industry of Thailand – Bangkok Bank, Kasikorn Bank, Siam Commercial Bank, Krungthai Bank, Bank of Ayudhya. The interviews are focused on eliciting views on the systemic nature of innovation, as well as the trend and pattern of technology diffusion in the banking industry.

The systemic innovation model (Table II) provides a dynamic tool to understand the progress and trend of innovation development. The quadrant classification attempts to divide the different types of innovations based on systemic nature (whether high or low systemic nature/characteristics). The criteria defining systemic characteristics are:

	Systemic innovation model	
	Low systemic nature	High systemic nature
Collaboration used (More than 1 party involved)	Quadrant 1	Quadrant 2
Collaboration not used (More than 1 party not involved)	Quadrant 3	Quadrant 4

Source: The author's design

- the innovation requires interoperability amongst third parties;
- the innovation needs necessary investment in assets specific to the system; and
- the innovation comprises extensive software (protocols, procedures) and hardware.

The high systemic innovation exhibits two or three of the above characteristics, whereas the low high systemic innovation exhibits one or none of the above characteristics. The model would be helpful for understanding the systemic characteristics of innovation and the pursuit of collaborative strategy in managing innovation to achieve a level of technology diffusion. The model can be applied to the innovations of any industry.

According to the systemic innovation model proposed in [Table II](#), the types of systemic nature can be categorised into four quadrants as follows.

### ***3.1 Quadrant 1: Low systemic nature and collaboration used***

The categorisation of innovations in this quadrant means that all the resources and capabilities required to achieve the level of innovation diffusion are available within a single economic entity or can be bought on a contractual (non-equity, non-participation) basis. However, in actuality, more than one party contributes to the delivery of products or services through commercial use.

### ***3.2 Quadrant 2: High systemic nature and collaboration used***

The categorisation of innovations in this quadrant means that the core business of innovation requires more than one party for viable diffusion. No obvious innovator has enough of the necessary competencies in-house, and there is no third-party market in which they can be acquired on a contract (non-equity) basis. Then, de facto, more than one party is involved in the delivery of products or services for commercial use.

### ***3.3 Quadrant 3: Low systemic nature and collaboration not used***

The categorisation of innovations in this quadrant means that the core business requires no more than one party for the diffusion of innovation. In other words, the deliverables of product or service innovations are within the capabilities of one firm or third-party contractors who will work on a non-equity basis.

### ***3.4 Quadrant 4: High systemic nature and collaboration not used***

The categorisation of innovations in this quadrant means that the capabilities for complete or maximum diffusion are required, but the supplementing capabilities are not available from third-party (non-equity) suppliers. If no more than one party in the delivery of products or services for commercial use is involved, then a failed innovation – an innovation that fails to achieve critical mass – is likely. The classification in this quadrant means that as the high systemic nature requires collaboration, however, if in practice collaboration has not been involved, then the innovation would not achieve a high level of diffusion. In other words, the innovation would fail to gain wide acceptance in the marketplace.

The systemic innovation model ([Table II](#)) will be applied in the next section. This model will be used to classify the systemic nature/characteristics of FinTech-based innovations (whether each type of FinTech-based innovations exhibit high or low systemic nature/characteristics). The classification is based on three characteristics of:

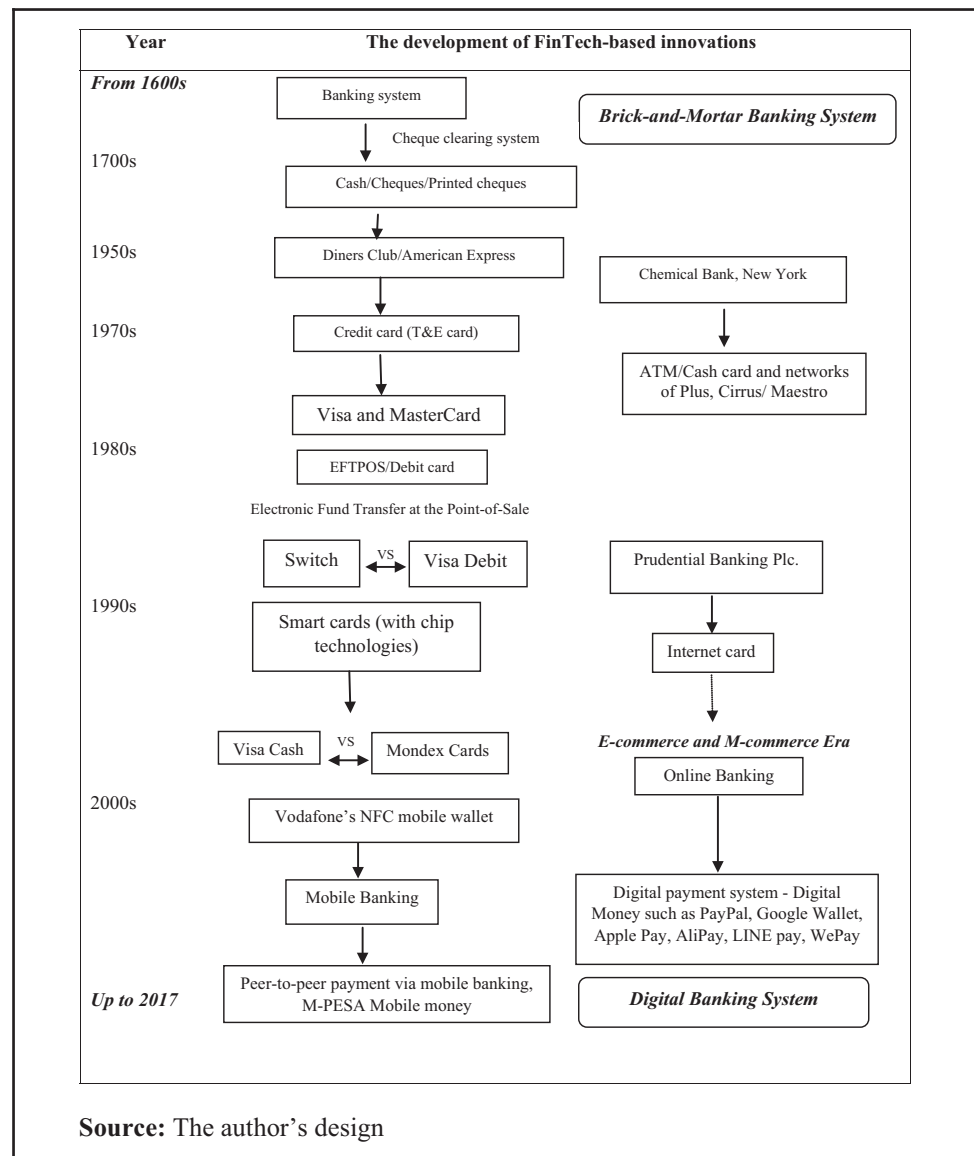
1. the innovation requires interoperability amongst third parties;
2. the innovation needs necessary investment in assets specific to the system; and
3. the innovation comprises extensive software (protocols, procedures) and hardware.

The systemic innovation model would assist in gaining a better understanding of the changing systemic characteristics and the dynamics of the banking landscape as FinTech-based innovations were launched in the financial services industry.

#### 4. The diffusion of FinTech-based innovations in the banking industry

Before exploring the systemic characteristics of FinTech-based innovations in the banking industry, Figure 2 portrays the development of FinTech-based innovations in the global financial services industry up to present. It is interesting to see the changing landscape from brick-and-mortar banking system towards digital banking system. The global financial services industry has witnessed a significant reform from the development of cheques, electronic cards and fund transfer system towards electronic payment system (Visa, MasterCard, Mondex), online (internet banking), mobile banking and digital banking. Under the changing banking landscape, many banks have adopted FinTech to improve the

**Figure 2** The development of FinTech-based innovations



efficiency of financial services. New competitors like non-banks also step into the financial system and use FinTech in offering financial products and services to compete with banks.

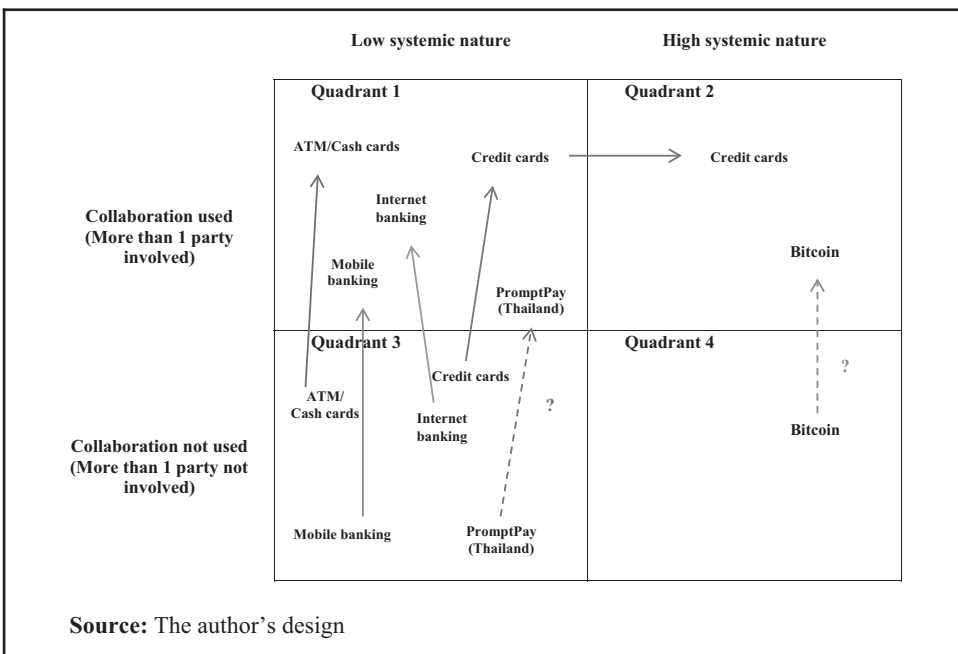
The analyses of FinTech-based innovations shown in Table III and Figure 3 below are performed using the systemic innovation model (Table II) to track the systemic nature/ characteristics over time. It shows the progression and dynamic characteristics of FinTech-based innovations along the innovation life cycle. The analyses of FinTech-based innovations have shown insightful results on the systemic characteristics of the innovation process. Table III presents the analyses of findings underlying the systemic innovation model which portray the pattern of technology diffusion in the banking industry.

**Table III** Systemic nature of FinTech-based innovations and pattern of technology diffusion

	Low systemic nature	High systemic nature
Collaboration used (More than 1 party involved)	Quadrant 1 ATM/Cash cards Internet banking Cheque guarantee cards Retailer cards Direct debiting Cash management account (CMA) Mobile banking	Quadrant 2 Electronic Fund Transfer at the Point of Sale (EFTPOS) Smart cards for financial applications (cards which provide payment functionalities such as debits/credits, the smart card e-cash) Credit cards International Electronic Fund Transfer (SWIFT, Eurogiro) Travel and entertainment (T&E) cards Cheque truncation Quadrant 4 Failed innovation
Collaboration not used (More than 1 party not involved)	Quadrant 3 Telephone banking Proprietary financial electronic data interchange (EDI) Fixed rate mortgages	

Source: The author's design

**Figure 3** The dynamics of FinTech-based innovations





The innovations with low systemic nature (Quadrant 1 and Quadrant 3 of [Table III](#)) have shown that the total potential benefits of the innovation are potentially available to be captured by a single entity (possibly buying missing capability on non-equity sharing purchase arrangements/contracts) and exhibit only one or none of the systemic characteristics. In other words, innovations having low systemic nature do not require collaboration, although for reasons of risk sharing and investment sharing, collaboration may still be evident. The analyses of findings have shown that innovations involving low systemic nature whereby banks have pursued collaborative strategy to realise the value of innovations (Quadrant 1 of [Table III](#)) are ATM/Cash cards, internet banking, cheque guarantee cards, retailer cards, direct debiting, cash management account (CMA) and mobile banking. The proprietary technologies that individual banks compete are telephone banking, proprietary financial EDI such as that developed by Citibank, fixed rate mortgages (Quadrant 3 of [Table III](#)).

While [Table III](#) presents the current status of systemic nature of FinTech-based innovations, [Figure 3](#) portrays the dynamics of FinTech-based innovations whereby the systemic characteristics change over time. It is argued that the complexity of innovation relative to the capabilities of innovators is the main issue in determining collaborative options. That is to say, innovators who lack appropriate resources in managing the complexity of innovation would seek to lower risks of competition or absolute investment by entering into collaboration. The use of collaboration then results in the systemic characteristics of the innovation process.

[Figure 3](#) portrays the dynamics of FinTech-based innovations. Although some FinTech-based innovations could be provided on an individual basis, innovators see the advantages of entering into collaboration to provide the service on an extended scope basis (external benefits). By pursuing collaborative strategy, banks could extend the scope of service beyond the limited scope of their own (internal benefits) without having to be involved in high investment costs. Also, the extended scope of usage can be regarded as a great benefit to customers, whose accessibility to banking services would be greatly improved. That is to say, when innovators use technology to facilitate the financial system networks to form interconnected networks (multiple platforms), this provides great benefits to customers. Interestingly, the empirical analyses have shown that the systemic characteristics of the innovation process are the outcome of interactions between the complexity of the innovation and the capabilities of innovators in managing the innovation.

Taking into account the samples of FinTech-based innovations shown in [Figure 3](#), banks can compete by launching ATM/Cash cards, internet banking and mobile banking on an individual basis (Quadrant 3 of [Figure 3](#)). However, banks attempt to overcome obstacles to achieve a level of diffusion by entering into a shared network. The FinTech-based innovations of ATM/Cash cards, internet banking and mobile banking thus progress from Quadrant 3 to Quadrant 1 as banks compete to pursue collaborative strategy in attempts to expand the bank networks which would allow them to capture more customers and increase their market shares.

In the case of credit cards, the innovation involved low systemic (Quadrant 3 of [Figure 3](#)) because banks competed to build proprietary networks nature when the innovation was first launched. Over time, they pursued collaborative strategy to extend the network services for improving service quality (Quadrant 1 of [Figure 5](#)). The innovation requires network externalities to complete the core and peripheral functions of credit cards, including issuers, acquirers, merchants, hotels, insurance and car rental company, etc. The credit card operation under the global payment networks of Visa and MasterCard system has finally determined the high systemic characteristics so as to facilitate the electronic payment (Quadrant 2 of [Figure 3](#)).

In the case of Bitcoin, the innovation has not yet achieved wide adoption in the global financial market at present. The main problem obstructing Bitcoin to achieve wide market acceptance is that the innovation is not backed by many governments and not recognised as a legal tender. The central banks of many countries around the world advise the users to be aware of the risks associated with Bitcoin usage because Bitcoin digital wallets are vulnerable to theft and loss. The competing mining protocol standards, the lack of collaborative solutions and the problems of insecure computer and internet infrastructure have hindered Bitcoin to achieve global adoption.

By applying the test of systemic nature/characteristics using the systemic innovation model (Table II) to track the pattern of technology diffusion, Table IV provides a summary of the systemic innovation characteristics of FinTech-based innovations in the banking industry. It is interesting to see that FinTech-based innovations such as EFTPOS, smart cards for financial applications (cards which provide payment functionalities such as debits/credits, the smart card e-cash), credit cards, international electronic fund transfer (SWIFT, Eurogiro), travel and entertainment (T&E) cards and cheque truncation involve high systemic nature (having two or three of the systemic characteristics).

In exploring the systemic characteristic of innovation in the case of Thailand, PromptPay FinTech reflects Thailand 4.0 policy focused on improving the national e-payment system. PromptPay is a government-sponsored programme to transform the banking system. Under the open government policy, commercial banks compete to acquire new customers so as to increase their share of mobile wallet market. PromptPay, a new FinTech-based innovation, functions as the electronic payment transfer for customer-to-customer (C2C), linking the citizens' identity (ID) and mobile phone numbers to the customers' bank accounts. The innovation provides a convenient channel for the customers to transfer and receive funds through the use of citizen ID numbers and mobile phone numbers instead of bank account numbers. It also provides government-to-customer (G2C) channel for tax refunds. The Thai government introduced PromptPay in 2016 as the e-payment system under the digital economy policy of Thailand 4.0. From Figure 3, it can be seen that the current state of PromptPay FinTech in Thailand is in Quadrant 3 where banks pursue competitive strategy to capture the payment market.

Under the growing e-banking landscape, it is interesting to see the trend that PromptPay FinTech is moving from Quadrant 3 to Quadrant 1. Banks pursue collaborative strategy with merchants to provide electronic data capture (EDC) services under the national e-payment system. The analysis based on the lens of the systemic innovation model has shown that the transition of PromptPay FinTech from Quadrant 3 into Quadrant 1 is likely to take place (a similar pattern like those of other FinTech-based innovations). The analyses of interview data carried out with major commercial banks in Thailand have confirmed this trend (the transition of PromptPay FinTech from Quadrant 3 into Quadrant 1) because customers need integrated and value-added financial services. The customers' requirements, thus, influence the systemic characteristics of innovation as they prefer the services not confined to a proprietary financial institution. Currently, the PromptPay FinTech landscape of Thailand has shown a trend of forming financial services consortia to expand e-commerce services. One consortium comprises Bangkok Bank and Kasikorn Bank. The other consortium (Thai Alliance Payment System) comprises Siam Commercial Bank, Krungthai Bank, Bank of Ayudhya, Thanachart Bank, TMB Bank and the Government Savings Bank. Such collaborative networks (consortia formation) can be seen as a response to avoid the failure of PromptPay FinTech, particularly in adoption and diffusion.

The analyses of findings in this section have shown that the diffusion of FinTech-based innovations has different levels of systemic characteristics. According to the empirical analyses based on the systemic innovation model, the systemic nature of innovation influences the need for collaboration and the process of technology diffusion. Taking into account the trend of FinTech in the future banking industry, it is argued that the

**Table IV** The systemic characteristics FinTech-based innovations

The systemic characteristics FinTech-based innovations	ATM/ Cash cards	Mobile banking	Bitcoin wallet	Proprietary financial EDI	Cheque guarantee cards	Direct cards debiting	Telephone banking	Blockchain banking	Retailer cards	CMA banking	Internet banking	Cheque truncation	T&E cards funding	Crowd EFPOS	Fixed rate mortgages	Smart cards for financial applications	International electronic fund transfer
The innovation requires interoperability amongst third parties					X			X				X				X	X
The innovation needs necessary investment in assets specific to the system	X		X	X			X		X				X			X	X
The innovation comprises extensive software (protocols, procedures) and hardware		X	X		X	X		X		X	X	X	X	X	X	X	X

**Note:** The high systemic innovation exhibits 2 or 3 of the above characteristics whereas the low high systemic innovation exhibits 1 or none of the above characteristics (as explained in the Methodology Section)

**Source:** The author's design

effectiveness of FinTech-based innovations needs high systemic characteristics because the ownership of networks and externalities seems to be an important factor in the diffusion process. That is to say, FinTech needs systemic characteristic to realise the value of technology and achieve wide market acceptance.

## 5. Research implications and conclusions

This paper is concerned with the diffusion of financial technology or FinTech in the banking industry. The study mainly contributes to the body of knowledge in financial innovations with respect to the systemic characteristics. The development of systemic innovation model provides a better understanding on the systemic characteristics, as well as the progress and pattern of technology development and diffusion. This research study provides useful implications to support the FinTech landscape of the banking industry.

The research findings suggest insightful implications that the systemic characteristics of the innovation process are dynamic over time. Innovators might adopt different strategies in exploiting the innovation along the stages of innovation, and this process, in turn, determines the systemic nature of the innovation. Interestingly, this research has shown that the systemic characteristics may change as coalitions and market sizes change. To put it another way, the systemic characteristics of the innovation process seem to vary with the size of the market. As innovators seek to enjoy the external benefits by pursuing collaboration, the pursuit of collaborative strategy may result in the systemic characteristics of the innovation process changing irreversibly. The case of PromptPay FinTech in Thailand's financial services industry poses a challenge for bank competition. This e-wallet system may need collaboration amongst banks to provide a powerful platform for promoting widespread adoption (the diffusion of PromptPay mobile innovation in the banking industry).

The analyses offer practical implications on the management of technology. The systemic innovation model is effective and useful in describing the progress of innovation diffusion. The model not only expands knowledge in the area of financial innovations but also points out the relation between technological complexities and the strategies used in driving FinTech-based innovations towards a competitive market with widespread use. Banks can learn the lessons of the systemic nature/characteristics of FinTech-based innovations, as well as the dynamics of the banking industry so as to pursue appropriate strategies in market competition (the ways the banks manage technological complexities and the use of technology strategy to improve its competitive position in the banking sector).

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