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Unveiling the interplay between blockchain and loyalty program participation: A qualitative approach based on Bubichain

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ABSTRACT

Keeping motivated customers partaking in point exchange activities is a major challenge in extant loyalty program (LP) studies. In the literature, IT or its applications play a paramount role in enabling firms to offer superior services and consequently deepen the relationships with their customers. Although already applied to augment customer experience and increase participation in practice, how blockchain applications interact with the LP context is still largely unknown in IS research. The objective of this research is to explore how blockchain, as an IT artifact on the rise, influences value creation in a LP context. Drawing on self-determination theory (SDT), this paper considers both intrinsic and extrinsic motivations in a LP context guided by SDT regulation: meeting the needs of Economy, Autonomy, Competence and Relatedness, and explores the effects of blockchain application on customers' motivations, which influence value perception and participative behaviors. By using an exploratory case study of BubiChain in China, we collected data through semi-structured interviews and extracted from the raw data of BubiChain-based loyalty point exchange platform, including real-time, multi-brands, peer-to-peer, and secure, traceable and fraud-proof exchange. We found that these features of blockchain applications not only improve customers' economic perceived value by meeting their extrinsic motivation but also enhance their social interaction and psychological self-fulfillment value perception by satisfying their intrinsic motivations, thus increasing customers' experience and participative behaviors. We also synthesized the results and theorized the findings into 4 formal testable propositions, which would offer testable hypotheses for future empirical studies. This paper reveals an innovative breakthrough on SDT theory and LP research, and is an early attempt to analyze how the blockchain is applied to LPs. We endeavor to establish a theoretical overview of how the key features of blockchain-driven point exchange platform influence customers' motivations, which affect value perception and consequently induce participative behaviors in a loyalty point context.

1. Introduction

In recent years, there is growing evidence that consumers are becoming disenchanted with the reward they receive for their effort in earning loyalty points (Alejandro, Kang, & Groza, 2016). A recent survey shows that the share of active loyalty program (LP) memberships in the U.S. kept around only 45% during 2014–2016 (Gutmann, 2018). In China, only less than half of the credit card points had been converted into the purchase by 2015, yielding a waste of value over $3.1 billion. To enhance customer engagement and stay abreast of competition, companies are seeking increasingly creative means for their loyalty points scheme design (Zhang & Breugelmans, 2012). However, the performance of the efforts rarely meets expectations, especially the low activeness of LP participation (Dowling & Uncles, 1997; Ferguson & Hlavinka, 2007; Kreis & Mafael, 2014). Reward points program is usually considered as an economic incentive, which enhances customer experiences and purchase retentions by ushering instrumental benefits of financial advantages (Mägi, 2003; Peterson, 1995). However, pertaining studies have reported that extrinsic (e.g. economic) rewards may undermine motivation and behaviors while intrinsic benefits tend to have a positive effect (Deci, Koestner, & Ryan, 1999; Meyer-Waarden, 2013). Therefore, new viewpoints and welfare benefits of consumers are warranted in the LP context (Lacey and Sneath, 2006). This paper is one of the early attempts to explore new LP designs based on blockchain applications vis-à-vis enhancing customers' participative behaviors.

Blockchain is deemed as one of the most innovative technological artifacts that will influence and morph business and society in the years

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to come (Webb, 2015; Kim & Laskowski, 2017). Major business service providers such as IBM, Deloitte, and Accenture have started using blockchain to alleviate the current plights of loyalty point scheme by reducing operating costs, accommodating multi-brands partnerships, and improving customer experience. However, as an embolic digital technology, both conceptual expositions and empirical evidence about how the blockchain applications improve LPs are deficient (Kshetri, 2018). In essence, scholars have yet to systematically assess the effects of blockchain on LPs because the blockchain deployment has been still largely experimental. The paucity of scientific knowledge in this growing yet paramount field no doubt warrants further investigations in LPs management. This study is an early effort to explore a theoretical underpinning and empirical knowledge about the way blockchain application influences customer LP engagement. Our research objective is to develop an in-depth understanding of the value perception in the context of blockchain-enabled LP participation. We strive to accomplish our research objective through an exploratory case study of a blockchain-based platform that offers loyalty point management services for brands and customers.

To address the gaps in the literature, this study attempts to advance this line of research in three primary ways, as follows:

- This paper reveals an innovative breakthrough on the SDT theory. In SDT, scholars focused on a single theoretical mechanism of either extrinsic or intrinsic rewards, and used empirical evidence to show that extrinsic rewards can undermine motivation and behaviors, whereas intrinsic benefits tend to have a positive effect (Deci et al., 1999; Meyer-Waarden, 2013). In this paper, we proved that extrinsic benefits of a loyalty point exchange activity can also enhance customers' motivation and behaviors, based on the blockchain-enabled features such as real-time, multiple, peer-to-peer, and fraud-proof exchange. Customers engage in the point redemption activity not only for a reward but also for their interest in the activity, thus feeling competent or pleasant to receive the reward.
- This paper is a novel supplement to the loyalty program research. According to the main streams of the literature on loyalty program, a company acts as a service provider and creates value for its customers through a LP to motivate their loyalty behaviors, while the customers are the service receiver and may perceive value in status, habits, and relationship (Henderson, Beck, & Palmatier, 2011). However, due to the low redemption rates of LPs around the world in recent years, new mechanisms for LP effectiveness need to be explored. In this paper, we built our theoretical foundation on the SDT and proved that blockchain allows customers to engage in LPs in a more self-determined way rather than just obeying the rules and perceiving the value passively. Blockchain enables customers to store all points in a single wallet for multi-programs management and there are broader choices for them for the redemption engagement, which satisfy the multidimensional innate needs (economy, autonomy, competence and relatedness) and motivate the customers to engage more.
- This paper is an early attempt to analyze the blockchain impacts on LP, as we endeavor to present a theoretical overview of how the blockchain-driven features influence customers' motivations, which affect value perception and consequently induce participative behaviors in a loyalty point context. We, for the first time, conducted an explorative case study of a successfully deployed LP project, and extracted the mechanisms as to how a blockchain application affects customers' value perception and behaviors. We also synthesized the results and theorized the findings into several formal testable propositions, which would offer testable hypotheses for future empirical studies in this field.

The rest of the article unfolds as follows: First, we discuss the pertaining literature and present our theoretical pre-understanding on LP design, customer motivations, value perception, and blockchain techniques. Followed is a description of our case organization, a brief discussion of the methodology employed in this study, and the interpretation of the case study data. We conclude with a discussion of the limitations, future directions, and the study's key conclusions.

2. Theoretical foundations

2.1. Self-Determination Theory and customer motivation in LPs context

According to existing research (e.g. Shugan, 2005), one primary reason why customers are becoming less interested in loyalty points is that their personal preferences and motivations are not satisfied in the current LP schemes. Loyalty points are in terms of future rewards or deferred rebates, and customers are usually limited on where and when they can spend them. With the objective of clarifying how LPs can enhance customers' participative behaviors, we start with an understanding of the motivations that drive customers' participation in LPs (Gwinner, Gremler, & Bitner, 1998). While there are many motivation-related theories applied in customer behavior study, consecutive research has come to the consensus that there are two main motivation categories driving human behavior: utilitarian motivations and symbolic motivations (Dorotic, Bijmolt, & Verhoef, 2012). Utilitarian motivation refers to the goal of obtaining external rewards or outcomes of executing an activity, and is primarily addressed by tangible benefits (Ryan & Deci, 2000). In the LPs context, extrinsic motivation can be achieved through gaining monetary advantages or attaining rewards (Peterson, 1995). Symbolic motivation, on the other hand, refers to the needs for self-esteem and social approval, or the inherent satisfaction of doing an activity (e.g. humans' natural tendency to engage in interesting and playful activities) (Kim & Ahn, 2017), which is more related to intangible benefits (Mimouni-Chaabane & Volle, 2010; Sweeney & Soutar, 2001). Due to the motivational variations that are potentially associated with LP participation behaviors, Self-Determination Theory (SDT) is an appropriate theory for this study (O'Donnell & Brown, 2012; Ryan & Deci, 2002). SDT, as developed by Deci and Ryan (1985), is a theory of motivation in which people are viewed as organisms actively looking for ways to satisfy their needs. SDT offers a theoretical framework to explain that individuals are motivated to satisfy their various basic needs: autonomy, competence, and relatedness, and indicates the importance of the satisfaction of the three needs for self-determined motivation, through engaging in activities as a function of intrinsic motivation and self-determined extrinsic motivation to flourish (Vallerand, 2000). Autonomy relates to the need to initiate our own actions and behaviors (Ryan & Deci, 2002), and competence refers to people's need to feel capable in exercising and expressing their abilities whereas relatedness concerns the need for interaction and connectedness to peers or communities (Ryan & Deci, 2002).

It is pointed that intrinsic motivation produces the most positive consequences, whereas certain types of extrinsic motivation (especially external regulation) and motivation produce the most negative ones (Ryan & Deci, 2000; Vallerand, 2000). Thus, an individual needs to be motivated in a self-determined fashion. It is noted that customers usually achieve the extrinsic motivation by attaining rewards, especially through the redemption of accumulated loyalty points (Wirtz, Mattila, & Lwin, 2007), thus we consider such motives that are primarily centered on financial advantages as an influential driver of LP participation. Therefore, we define customers motivations for LP participation as the following four dimensions: *Economy* (extrinsic motivation, a sense of saving money from LP activates), *Autonomy* (intrinsic motivation, a sense of internal assent of one's own actions and behaviors), *Competence* (intrinsic motivation, a sense of feeling effective and capable in exercising and expressing personal capabilities), and *Relatedness* (intrinsic motivation, a sense of connection and interaction with others) (Meyer-Waarden, 2013; Ryan & Deci, 2002; Shi, Cristea, Hadzidedic, & Dervishalidovic, 2014). Furthermore, SDT suggests that various rewards and contexts have differential effects on varying

motivation (Deci & Ryan, 1985).

2.2. Customer perceived value in LPs context

Customer perceived value is considered the fundamental basis for all marketing activities (Holbrook, 1994). It is grounded in equity concept, which refers to customer's evaluation of the relative rewards and sacrifices associated with company's offerings (Oliver & DeSarbo, 1988). Perceived costs include both monetary payments and non-monetary sacrifices such as time consumption, physical/energy paying, and mental stress experienced by customers during the purchase process (Yang & Peterson, 2004). Customers are inclined to feel equitably treated if they perceive that the ratio of their outcomes to inputs is appropriate (Oliver & DeSarbo, 1988).

Prior empirical research has recognized customer perceived value as a critical determinant of loyalty behaviors (e.g. repeated purchase intentions) in such contexts as telephone services (Bolton & Drew, 1991), airline travel, and retailing services (Sirdeshmukh, Singh, & Sabol, 2002). In the LPs context, customer value regulates loyalty behaviors toward the LP providers as long as the pertinent transactions provide superior value (Sirdeshmukh et al., 2002). While motivations for LP participation represent consumers' needs related to an LP, perceived value embodies the overall evaluation of the utility of the LP to satisfy those needs (Kreis & Mafael, 2014). Consumers' motivations have an influence on increasing the perceived value of partaking a LP which acts as a cognitive driver of subsequent participative behaviors (Polo & Sesé, 2009; Woodruff, 1997; Wyer & Xu, 2012). Thus we connect the customer motivations with actual value perception that results from satisfying those needs. When a LP is designed to be effective (cheaper, easier, faster, and/or more secure over points accruing and redemption), it can deliver varying perceived value to different customers.

To obtain a detailed understanding of how customer motivations and value perception are connected, it is necessary to consider customer value as a multidimensional, personalized concept in the loyalty point context. In a theoretical review paper of LP effectiveness, scholars argue that LP-induced change to consumer behaviors typically results from customers' mental processes (Henderson et al., 2011). Instead of a direct price discount, the constant accumulation of loyalty points may remind consumers or raise their interest in the LPs and enhance the psychological value associated with the pleasure of earning and redeeming points (Leenheer & Bijmolt, 2008). Besides, the rules of the loyalty point scheme may provide sociological benefits and stimulate consumers to join the LPs, since they recognize a sense of belonging to an exclusive community of privileges (Barone & Roy, 2010). In light of the preceding discussion and findings, it is proposed that customer value perception in the loyalty point context can be classified into three categories: *Economic utility* (primarily relates to and stems from financial advantages, such as money saving or gifts offering, and can be connected with extrinsic motivations). *Psychological self-fulfillment* (emphasizes a product's ability to enhance customer's self-concept and can be connected with intrinsic motivations), and *Social interaction* (can be derived from feelings of belonging to a community/like-minded peers or having relationship with a brand or company, and can be connected with intrinsic motivations) (Kreis & Mafael, 2014; Sheth, Newman, & Gross, 1991; Sweeney & Soutar, 2001).

2.3. Blockchain application in LPs context

2.3.1. The role of LPs design in LP efficiency

Recent research about LPs effectiveness focuses on accounting for LPs design elements (choices, requirements, deadlines, and reward options) as a feasible approach to the controversies concerning the usefulness of LPs for value creation (Evanschitzky et al., 2011; Kumar & Shah, 2004). LPs vary enormously in their design, which exerts an impact on LP effectiveness (D'Astous & Landreville, 2003; Liu & Yang, 2009; Nunes & Dréze, 2006; Zhang & Breugelmans, 2012). Several studies have looked at the design of LPs to examine how much a consumer has to spend to receive a loyalty point (e.g. Dorotic et al., 2012; Roehm, Bolman, & Roehm, 2002), whereas some other studies have examined the fairness of redeeming loyalty points based on equity theory (Danaher, Sajtos, & Danaher, 2016; Kwong, Soman, & Ho, 2011). Furthermore, a variety of studies base their analyses on psychological mechanisms and examine the undermining effects of extrinsic rewards on intrinsic motivation in the context of LPs (Kim & Ahn, 2017; Kim, Shi, & Srinivasan, 2001). However, the extant studies rarely take IT factors into consideration as a key resource of LP design for enhancing LP effectiveness, although in recent years more and more companies adopt IT application into supplying better services and improving customer experiences.

2.3.2. Blockchain application in LPs design

Blockchain is described as a distributed database technology that originates from bitcoin (a cryptocurrency based on a peer-to-peer payment system) and facilitates distributed ledger to record verified, tamper-resistant transactions across network participants (Nakamoto, 2008; Glaser, 2017; Ying, Jia, & Du, 2018). In contrast to the traditional trust mechanism where a central party (e.g. an insurance company, a central bank, or the government) is needed, blockchain is a "trust-free" solution, where the technical part assures the transactions not to be altered as long as it is logged on the blockchain. If the data is changed, no transaction will take place, which makes the system inherently secure (Beck, Czepluch, Lollike, & Malone, 2016). Since its inception, blockchain use has expanded into a wide range of industry sectors beyond the financial domain, such as the energy sector (Lavrijssen & Carrilo, 2017), the supply chain & logistics sector (Iansiti & Lakhani, 2017; Korpela, Hallikas, & Dahlberg, 2017; Kshetri, 2018; Queiroz & Wamba, 2019; Tian, 2016; Tönnissen & Teuteberg, 2019), the music industry (Rethink Music Initiative, 2015), employment management (Ying et al., 2018), and a number of other innovative applications such as secure contracts, e-health records and land management (Hoy, 2017; Hughes et al., 2019; Thakur, Doja, Dwivedi, Ahmad, & Khadanga, 2019). Up to now, little is known about the implications of blockchain for customers' loyalty point activities.

Business and information technology (IT) service providers (e.g. IBM, Deloitte and Fujitsu) have launched blockchain-based data storage system that can be used by merchants to tokenize their loyalty points. Typically, the system is supposed to be integrated with the promotional activities of merchants in shopping centers or chain restaurants that allow consumers to spend digital points received from one store at different outlets. Within such a system, consumers purchase goods and services with points obtained from flight mileage, hotel bonus, gas cards, and retailer rewards at near real-time, or transfer their points to peers. However, many of the blockchain-based LP projects remain in corporate announcements of intention, while few are currently in deployment.

Blockchain is a class of particular technologies which are called distributed ledger technologies, including *hash values* (used to validate the block's integrity, any changes to the transactions that make up a block will alter the hash value of the block as a whole), *asymmetric key encryption* (used to create and authenticate identities on the blockchain), and *peer-to-peer networks* (decentralized and interconnected network that shares tasks between all participants equally which allows for redundancy of the data in the blockchain) (Beck, Müller-Bloch, & King, 2018; Jaikaran, 2018).

From a resource-based view, IT or its applications play a significant role in enabling firms to offer superior services and consequently deepen the relationships with their customers (Melville, Kraemer, & Gurbaxani, 2004; Ray, Muhanna, & Barney, 2005; Zhang, Agarwal, & Lucas, 2011). The core of the theoretical analysis of this research is to explore how blockchain, as an information technology on the rise, influences value creation in a LP context. Motivation analysis based on SDT has already been applied in the context of education (e.g., Dadiz &

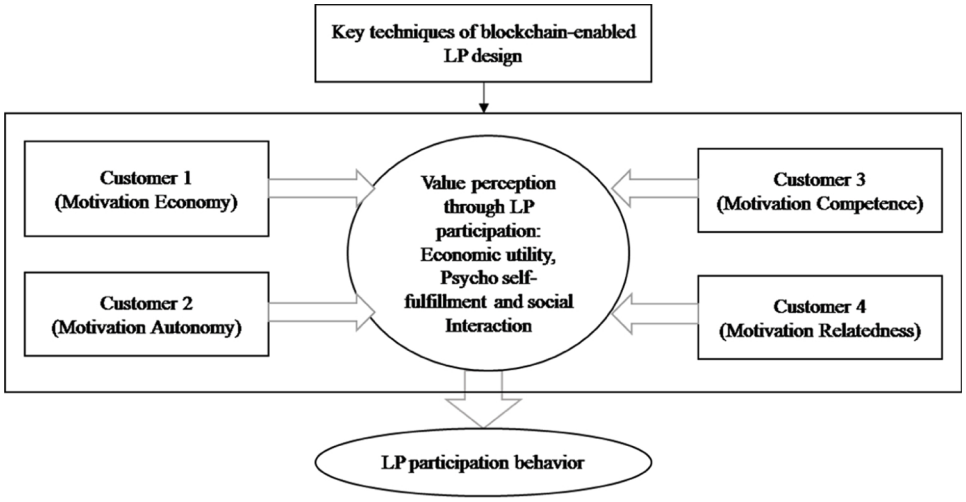

Fig. 1. Literature-based pre-understanding of the effects of blockchain on LP participation behaviors.

Baldwin, 2016; Shi et al., 2014), pro-social behavior (e.g., Osbaldiston & Sheldon, 2003; Weinstein & Ryan, 2010), and customer loyalty (Kim & Ahn, 2017; Meyer-Waarden, 2013; O'Donnell & Brown, 2012). This paper considers four types of motivations in a LP context guided by SDT regulation: meeting the needs of *Economy, Autonomy, Competence* and *Relatedness*, and exploring how these motivations can be affected by blockchain techniques, thus influencing subsequent value perception and customer behaviors. We suppose that different customers participate into the loyalty point exchange activities while being initiated by different motivations, and the dominant natures of blockchain application influence the process of their value perception during their participation which impacts their cognition and behaviors to such projects (see Fig. 1). In the following part of this paper, we will prove and specify our proposition with an exploratory case study.

3. Case study and methodology

3.1. Case background

Bubi Technologies Co., Ltd. (Beijing, China) is a leading blockchain fintech company in China (www.bubi.cn), which focuses on blockchain technology development and product innovation. Bubi began to engage in blockchain technology R&D early in 2012, and the company was officially established in March 2015. In December 2015, Bubi launched the first blockchain business application in China, which is a loyalty point platform based on BubiChain, a blockchain independently developed by Bubi company. Holding dozens of core patented technologies, BubiChain has been used in the management of digital assets, trade finance, equity bonds, supply chain traceability, loyalty points, joint credit, public notarization, electronic invoices, and data security, and has carried out trials and tests at major financial institutions (e.g., exchanges and banks). Sunshine Life Insurance, People's Insurance Company of China, CITIC Group, Haier Financial Holdings, and other large companies are BubiChain's initial users and have built their digital assets (e.g. loyalty points) on the mid-term BubiChain support system. By the end of 2017, Bubi has completed A-round financing that exceeded $25 million.

We chose BubiChain as a single case because many of the current blockchain-based LP projects still de facto remain in corporate announcements of intention, while BubiChain has successfully been applied to practice – a decentralized point exchange system, which supports loyalty point activities among the merchants and individuals of a shopping district in Guangdong province, China. 209 brands of the shopping district have accumulated just 2000 members during the last two years. Since BubiChain was deployed in February 2018, it has attracted over 20,841 customers to use the blockchain-based point cards within one week, according to the Manager of Loyalty Point Business of Bubi.

3.2. Methodology

Due to the lack of empirical evidence in extant Information System (IS) research, we adopted the qualitative case study approach which helps investigate new phenomena embedded in a specific context (Eisenhardt & Graebner, 2007; Sandeep & Ravishankar, 2015). An exploratory case study (Kotlarsky, Oshri, van Hillegersberg, & Kumar, 2007; Yin, 2003) was adopted as an approach to understanding how blockchain techniques affect customer motivations and subsequent participative behaviors in a LP context. One case study is appropriate for examining complex or new phenomena (Klein & Myers, 1999) and processes (Gephart, 2004), and for addressing the "how' and "why" questions (Walsham, 1995; Pan & Tan, 2011). An in-depth case study of BubiChain-based loyalty point platform was carried out and led to the discovery of how and why the blockchain, as an emerging IT artifact, is applied in LPs on value perception for different motivated customers guided by SDT.

To achieve scientific interpretivism and realism, we adopted a qualitative, interpretive approach with the goals of seeking:

1 What are the key techniques, structure, and main characteristics of the BubiChain-based loyalty point platform?
2 How does BubiChain influence the value perception of customers with different motivations?

3.3. Data collection and analysis

Data was collected through semi-structured interviews and other documentary evidence (Recker, 2013; Rose, Spinks, & Canhoto, 2015; Sarker, Sarker, Sahaym, & Bjørn-Andersen, 2012; Silverman, 2011). Data collection continued until theoretical saturation was reached, that is, findings from the interviews were getting repetitive and the incremental information provided by additional interviews were judged to be insignificant (Eisenhardt, 1989; Pawlowski & Robey, 2004; Rowley, 2002). Finally, 4 informants were from the IT & business groups of Bubi company, and 20 informants were users of the BubiChain-enabled LP platform.

Firstly, for understanding the structure and key natures of the blockchain-based loyalty point platform, we interviewed the primary representatives of the project team that developed and executed the platform. The team consisted of Bubi's Chief Operation Officer (i.e.,

R1), the Chief Technology Officer (i.e., R2), the manager of loyalty point department (i.e., R3), and a blockchain engineer (i.e., R4). Interviews were approximately 30 min in length for each interviewee and were recorded. Each interview started with a set of introductory questions regarding the respondent's background, current position as well as his/her role in the project. Thereafter, we asked each respondent to describe the technical architecture and most critical characteristics with respect to the platform from his/her viewpoint. In each section, questions were similar for all interviewees, while certain questions were based on the position and expertise of the interviewees (Pacauskas, Rajala, Westerlund, & Mäntymäki, 2018). Next, we conducted the interviews with 20 platform customers (i.e., C1-20) under the four major theoretical categories of SDT motivations (economy, autonomy, competence and relatedness), and attempted to discern the cause-effect relations among blockchain adoption, customer motivations, and value perception. All interviewees declared that they were able to express their viewpoints freely. The objective of the interviews was to understand how the platform customers subjectively perceived their motivations to be satisfied by the platform characteristics, and the questions focused on their needs, feelings, and future intentions of participating in the loyalty points activities on this platform.

To complement the potentially incomplete knowledge acquired from semi-structure interviews, we collected several documents including company magazines, newsletters, internal journals, and archival reports. In addition to the documents provided by Bubi, we also collected a number of reviews and articles on BubiChain and its services for loyalty point management in online newspapers and business magazines. These documents helped us better understand some of the complex technical concepts and the key natures of the BubiChain-based LP platform, and helped us corroborate our findings obtained from empirical materials (Dremel, Herterich, Wulf, & vom Brocke, 2018; Zhang & Ravishankar, 2019; Zhang, Pan, & Ouyang, 2019).

We used open coding technique during the process of analyzing the empirical material, which is widely used for qualitative data analysis (Bryman & Burgess, 1994; Strauss & Corbin, 1990). Three investigators developed a coding template. Each investigator received comprehensive training in the use of the coding instrument before any actual coding commenced. Preliminary reliability tests were conducted using Krippendorff's (2004) *alpha* to identify variables. Based on these preliminary reliability tests about how to codify certain types of content, adjustments were made to the coding variables to ensure that coders were using the variables accurately and consistently. Open coding was performed on each of these transcripts and the process repeated multiple times. From the open codes identified in each interview, we selected core codes. Then, we searched for similar variables across interviews. We began looking for variables that appeared in more than one interview. In this study, credibility was established by repeating a summarized version of their response. Interviewees were asked to confirm if that is the message they were communicating. Then, we structured our observations of BubiChain into three categories according to our literature-based analytical framework: (1) basic structure and critical techniques of BubiChain, (2) functions and key characteristics of BubiChain-based loyalty point exchange platform, and (3) assessing customer motivations, value perception, and future intentions. After all, the analysis of the empirical observations allowed for the influence of BubiChain's key characteristics on customer behaviors in the decentralized loyalty point exchange activities.

4. Findings

4.1. BubiChain platform structure

The BubiChain platform adopts a three-layer structure: (1) the underlying BubiChain, which provides basic blockchain service; (2) the application adaptors, which models and adapts to provide a series of interfaces and reduce the complexity of application docking, and (3) the upper application interfaces that conform to various application scenarios.

4.1.1. The underlying architecture of BubiChain

The underlying technical architecture of BubiChain consists of the P2P network, distributed ledger, and consensus service. Firstly, the P2P network implements basic networking and communication, while each node on the network maintains a neighbor list to implement a dynamic self-organizing network. Secondly, the distributed ledger is used to solve the problem of data format, data record, and data storage, which determines the blockchain's ability to provide external services. Finally, consensus service guarantees strong consistency of the underlying data while resisting the effects of malicious people, which is considered the core of blockchain and the biggest difference from the traditional distribution system. Concerning the structure of BubiChain, some interviewee noted that:

> BubiChain is a blockchain technology infrastructure independently developed by Bubi's core team from 2012, whose source code is openly licensed on GitHub. It has multiple branches and is constantly being updated. Bubi's consensus service adopts an open framework to support different kinds of consensus algorithms and provides an abstract set of consensus interfaces for connecting consensus algorithms and other BubiChain modules. Currently, BubiChain has developed the commercial consensus algorithm of Byzantine Paxos and Byzantine Raft and supports consensus algorithms such as PBFT, which can meet the requirements of performance, security and fault tolerance according to the upper layer applications. (R2)

Besides, the underlying managerial architecture of BubiChain provides security and strategy mechanisms. Once the transaction has been validated and recorded, the underlying cryptographic technologies which are responsible for the digital signatures and data integrity (Pan, Pan, Song, Ai, & Ming, 2019), can not only maintain the configuration and security of the blockchain system itself but also manage the access policy and privacy security of the storage data on blockchain. As interviewee noted that:

> BubiChain is a permissioned blockchain, upon which participant is permitted to join, real name authenticated, and is limited to access the data on the blockchain. The security mechanism of BubiChain is responsible for solving security issues such as system networking, interface access, consensus algorithms and data privacy, while the strategy mechanism includes node deployment strategy, data access limits strategy, multi-sign joint control strategy, compliance strategy, and performance strategy, etc. (R4)

4.1.2. The upper application components and interfaces

In order to facilitate the application layer understanding and docking, an application adaptor layer is designed and used to abstract 4 components: *Asset*, *Record*, *Transaction,* and *Contract*, in support of the upper API interfaces for various business scenarios, such as digital assets, supply-chain finance, traceability, and deposit certificates, etc.

Component *Asset* supports circulation of digitized assets; component *Record* is used to increase the authenticity and trust in information recording scenarios, such as financial credentials, supply-chain traceability, etc.; component *Transaction* interacts with the underlying blockchain at an atomic-level, while an upper-level application can correspond to one transaction or a group of transactions; and component *Contract* provides two types of contracts: standardization contracts and programmable contracts. BubiChain provides a template for common scenarios such as digital assets and deposits, where users only need to change the key parameters of the template and add the characteristics of their own business to build a mature contract application, as noted:

Blockchain is an emerging technology. Only by continuously meeting the needs of the business can we mature. Therefore, we reduce the threshold of the upper-layer application by continuously optimizing and improving the underlying distributed ledger and consensus algorithms in the process of docking and use, in order to make them more relevant to commercial appeals. (R2)

4.1.3. Visualized managerial tools

To assure the underlying security & strategy mechanisms and to support the upper application interfaces, the application adaptation layer also provides a range of visualized managerial tools: *System configuration* mainly provides visual configuration operations which are set up flexibly in light of security, strategy, authority, blockchain node, distributed ledger structure, consensus algorithm, system parameters, etc.; *Monitor* provides three dimensions of monitoring: physical layer (CPU, memory, disk, etc.), network layer (delay, disconnection) and business layer (block generation, transaction verification), and a comprehensive mechanism including alarm, log, and message notification is deployed to facilitate the operation and maintenance of commercial application systems; *Data statistics & analysis* is used to meet the requirements of complex data analysis of the upper application, which provides both standard and customized interfaces for data query, volume export, and subscription; and *Blockchain browser* can reveal the data information stored at the bottom of the entire blockchain, including information of block, account, transaction, and contract. This is as noted by interviewee:

In the new business scenario, Bubi can quickly customize the interface based on the existing framework to meet the requirements of business functions. At the same time, it provides packaged SDK development kits that support multiple mainstream development languages (e.g. JAVA, C++, node-js, PHP). (R1)

4.2. The key characteristics of BubiChain-based loyalty point exchange platform

4.2.1. Functions

Corresponding to the basic architecture of BubiChain, the loyalty point exchange platform based on BubiChain has a three-layer structure: (1) the underlying BubiChain, (2) the application adaptors, and (3) the upper application interfaces, as shown in Fig. 2. Various entities (individuals, institutions) can register and distribute their own loyalty points on the platform. The application adaptor layer includes components of *Asset (Account center), Record (Merchant backstage), Transaction (Recharge & consumption)* and *Contract (Point management)*, and visualized managerial tools of *System configuration, Statistics & analysis, Risk control,* and *Payment channel*. The application interfaces provide basic services for loyalty point activities, such as *Register, Point redemption, Point transfer, Individual center, Merchant center*, etc., as shown in Fig. 3.

Based on this structure, BubiChain loyalty point platform allows participating agents to intersect and interact on a trustless distributed ledger, without intermediaries and compromising privacy. For the merchants who issue loyalty points on the system (e.g. Sunshine Life Insurance), BubiChain is able to streamline execution and administration of their programs with near-real-time transparency due to its standardization contract component. Otherwise, the merchants that have their own LP platforms connect the system with their existing networks and control how their customers access and redeem their points through BubiChain's programmable smart contracts. Due to the basic distributed ledger architecture, the platform accommodates different and multiple merchants and their loyalty programs, facilitating the loyalty point convertibility and exchange.

For the merchant, he/she first registers an institutional account on the platform and generates a pair of account and private key from the underlying BubiChain. After he/she gets a point issuance account, he/she can issue his/she own points which are injected into the underlying BubiChain. After the issuance, the merchant can see the number of points in his/her account. It is possible to achieve the exchange of points between institutions, while the transaction records and account balances are recorded on the blockchain ledger, and real-time liquidation between merchants is realized; for the user, he/she can carry out the loyalty point transaction or transfer through the interfaces of the platform, which maximizes the convenience of the user's point circulation, and different points' classification and consumption. (R1)

4.2.2. Characteristics

We used NVivo 11 to explore and present the links between project items. NVivo is a qualitative data analysis software package and is designed for qualitative researchers working with text-based and/or multimedia information. In this project, we used a project map which is

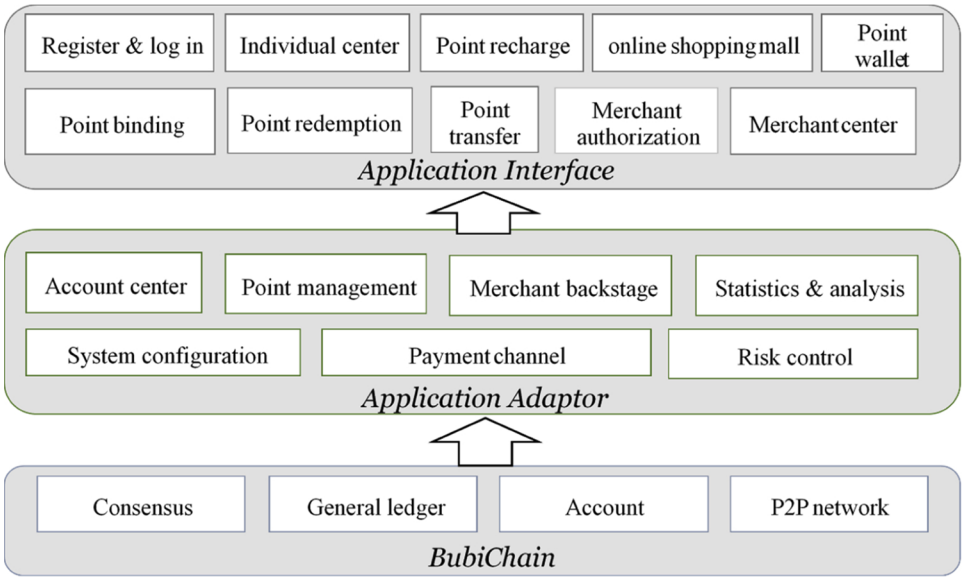

Fig. 2. Structure of the BubiChain based loyalty point exchange platform.

Fig. 3. Application interfaces of BubiChain loyalty point platform.

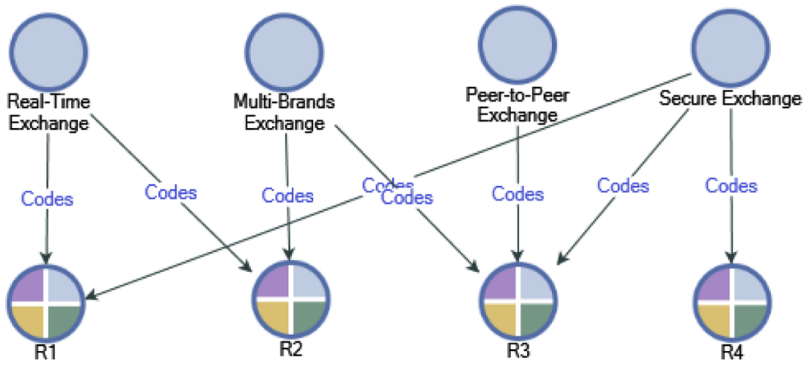

Fig. 4. Coding Map of Characteristics.

a graphic representation of the different items. To create a project map, we drew a map showing the relationship between each interviewee and corresponding responses. Then, we added other associated items to help illustrate the result. The project map of the interview result of Bubi's executives and project team members is depicted in Fig. 4.

One notable issue is to examine the key characteristics of the blockchain-enabled loyalty point system, which is rarely seen in the extant literature. In the case of BubiChain, there remains a strong relationship between BubiChain's basic structure and its characteristics. We extracted the data from the interviews, and the question is "*what characteristics does BubiChain loyalty point platform have, compared to the non-blockchain platform*?"

Firstly, the underlying consensus mechanisms of BubiChain provide a consolidated, consistent dataset with near-real-time reference data, and the flexibility for participants to change the descriptions of the assets they own. The combination of blockchain techniques that allow for the automatic execution of transactions (Lacity, 2018; Schuetz & Venkatesh, 2019), makes the loyalty point circulation change from the original single-center control to the social circulation, thus promoting the volume and efficiency of circulation. As 100% of the respondents noted, BubiChain-based system can realize near real-time exchange of loyalty points. As emphasized by representatives:

> The basic characteristics of blockchain-based trading are to make real-time clearing possible, which greatly improves the efficiency of post-transaction processing and real-time query of point circulation. (R1)
>
> BubiChain's transaction confirmation time does not exceed 1 s (32 nodes, 4 core 8 G memory, 100 M bandwidth), so the transaction can be verified near real time. (R2)

Secondly, BubiChain's underlying distributed structure (account, ledger) and programmable contract in the application adaptor layer enable multi-assets account accommodation, so the platform is able to support multiple digital assets. As 100% of the respondents mentioned, BubiChain-based system supported the exchange of multiple loyalty points among merchant and individuals on the platform. As emphasized by representatives:

> BubiChain's distributed account and ledger structure enables the multi-assets account, so the loyalty point exchange platform based on BubiChain is able to support multiple digital assets, whereas previous blockchains could only support one single asset. Besides, based on programmable smart contracts, BubiChain allows loyalty point issuers to manage their points respectively. These points can be customized for expiration dates and other attributes. (R2)
>
> As long as these two merchants have joined our points exchange platform, their points can be exchanged with each other, and consumers can exchange their points in multiple stores no matter which one they hold. (R3)

Thirdly, due to the distributed ledger on underlying architecture and peer-to-peer transparency, BubiChain-based loyalty point system allows points to be exchanged among participants, without relying on any centered issuer system. As 100% of the respondents indicated, BubiChain-based system supported the peer-to-peer exchange of loyalty points on the platform. As emphasized by representatives:

> The points issued on BubiChain platform are asset-type, which can be given, merged, consumed, and circulate conveniently. In the past,

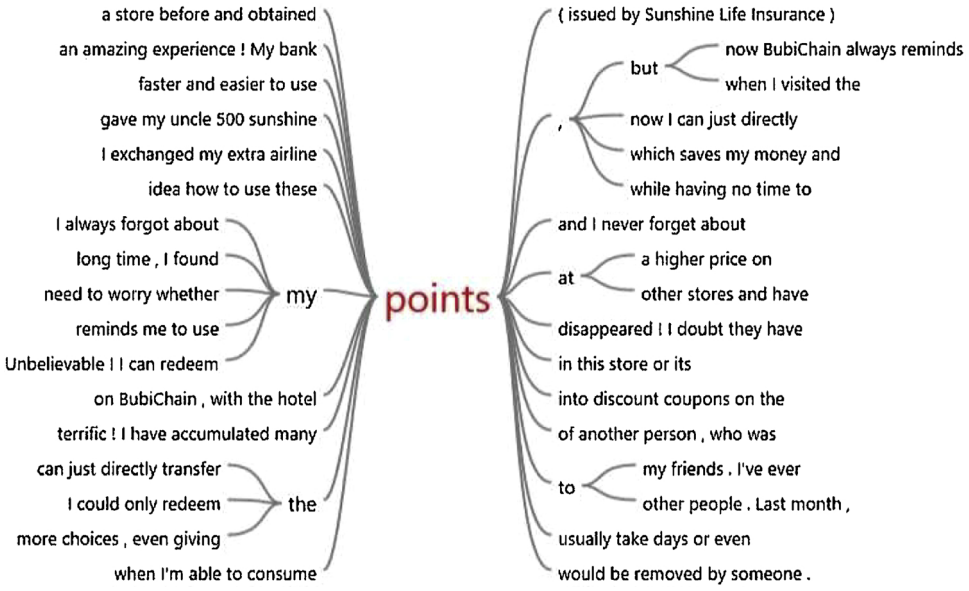

Fig. 5. Text Search Query showing participation and activities.

consumers accrued and consumed points in one store, but could not use them in other stores. Now on BubiChain platform, points can circulate from one store to another, so consumers can redeem the points of one store at another store by their preference, and even transfer to other individuals. (R3)

After joining the point exchange platform, merchants can have their points possess the asset attributes, which are able to be issued and circulated more conveniently on this platform, and consumers can give their points to each other. (R4)

Finally, the underlying consensus algorithms ensure that the shared ledgers are exact copies, and lowers the risk of fraudulent transactions. Besides, the peer-to-peer network prevents any single participant from undermining the underlying infrastructure and the entire system, since participants in the network are all equal and the system records the chronological order of transactions with all nodes agreeing to the validity of transactions. As a result, transactions on the blockchain cannot be altered or reversed, unless the change is agreed to by all members of the network. As 100% of the respondents noted, loyalty point exchange on the BubiChain is secure, traceable, and tamper-proof. As emphasized by representatives:

The blockchain builds a more secure underlying system than the traditional distributed ledger, by the private key signature transactions and consensus algorithms. (R1)

The points issued by each merchant cannot be forged, falsified, or deleted. The point on BubiChain platform have its unique identification, and the circulation of it can be tracked and stored on the entire network. Even if 99% of the networks are shut down, the point information would not be lost. Therefore, a customer's dominance of points and value are increased. (R3)

BubiChain's account structure allows all points to be marked and given an unforgeable identity through algorithms and real-name authentication. Therefore, the platform has the ability to provide multiple levels of security and achieve rights management. (R4)

It is important to understand that the above natures are not exclusive for the blockchain-based platform. For example, some non-blockchain platform can also support peer-to-peer exchange. But the blockchain-based platform possesses all the natures concurrently, that is, processing and confirming transactions upon a peer-to-peer network at near real-time while assuring tamper-resistant. By using blockchain-based shared ledgers where transactions cannot be altered once validated by consensus and logged to the ledger, transactions can save time and costs while reducing risks.

Finally, we outlined the main key characteristics of blockchain-enabled LP design as follows: *Real-time exchange* (realizes near-real-time exchange and redemption of rewards points, by lowering the amount of time [to seconds] firms take to process transactions and data), *Multi-brands exchange* (accommodates multiple brands and their LPs, while facilitating their interaction in terms of the convertibility and exchange of the points), *Peer-to-peer exchange* (allows the access to the connections with peers in social communities, and supports deals between individuals with reciprocal goals and demands), and finally *Secure, traceable and fraud-proof exchange* (creates an immutable and time-stamped distributed database entry for every single transaction, preventing double spending or any fraud, abuse of the transactions). Internal documents of BubiChain (see Appendix A), public webpages of BubiChain (see Appendix B) and online news & articles (see Appendix C), that is, 24 documents in total, were used to corroborate findings.

In the following, we discuss how the unique features of BubiChain-based platform affect the customer motivations and subsequent behaviors. Since the public online comments of users are scarce, our conclusions would mainly depend on the results of interviews with 20 customers, whom are randomly selected from the WeChat group of BubiChain loyalty program users.

4.3. How BubiChain impact LP participation

Below we will explain the ways BubiChain influences LP engagement behaviors of customers. In this part, all the dialogues are focused on the users' participation in the point(s) redemption and exchange activities, why they joined (motivation), how they felt (value perception), and whether they would join again (behaviors). To understand the user's participation and exchange activities, we created a word tree as part of the text search query in NVivo. A text search query allows a researcher to find all occurrences of a word, phrase, or concept in the project. The tree map provides a way for researchers to gain an essential idea of the word use. We found that "point(s)" is the most frequent word and connects all notions in the project (Fig. 5).

Our interviews in this part are guided by the four SDT-based motivations: Economy, Autonomy, Competence, and Relatedness. The results of the data analysis are depicted as the coding map below. Then we will explain the results guided by the various motivations respectively.

4.3.1. Towards satisfying the need of Economy

Customer's economic motives could be satisfied when he feels that he pays better prices, acquires special gifts, gets more discounts than most customers, or just saves money or time by engaging in the LP (Gwinner et al., 1998; Long & Schiffman, 2000). Primarily, customer perceives *economic utility* value when his need of *Economy* is satisfied (e.g. it is economically reasonable for me to engage in points redemption, the LP offers me additional value for my money, etc.) (Mägi, 2003; Peterson, 1995).

The questions in this part were: "Do you want to save/earn money on the BubiChain-enabled point exchange platform? Has your goal been achieved?" If the answers were both positive, then the respondent was a customer with *economic* motivation, and his/her motive of economy was satisfied by the BubiChain-enabled point platform. At last we discussed about the question of "will you take part in the platform again?" to test their future participation behaviors.

As a result, 6 respondents were identified as the customers with economic motivation, since they claimed that they had the motivation of earning/saving money, their need of *Economy* had been satisfied in the process of the point exchanging activities, and promised to participate again. 33% of them (2 out of 6) (C1, C2) explained that the characteristic of *multi-brand exchange* of the platform made it more convenient and flexible for them to save/earn money on the platform; 33% of them (2 out of 6) (C13, C14) noted that it is more flexible to save/earn money on the platform through transferring the points directly between individuals due to the characteristic of *peer-to-peer exchange*; 33% of them (2 out of 6) (C3, C13) implied that the near *real-time* point exchange has a strong focus on economic motivation by saving their time and reducing loss, consequently adding economic utility value to their decision of engaging the LP repeatedly; and 1 of them (C16) claimed that the blockchain application with *secure exchange* characteristic satisfied the need of saving their assets from being eliminated, and thus enhanced their intention of participating again. As noted:

> Unbelievable! I can redeem my points into discount coupons on the BubiChain platform! I've never imagined this before! (C1)
>
> Last week, when I planned to prolong my vacation, I exchanged my extra airline points at a higher price on BubiChain, with the hotel points of another person, who was eager to get a timely flight. It's really an amazing experience! (C2)
>
> In the past, I accumulated too many loyalty points, and could not be able to consume all of them before they got expired. Now, the points can be transferred to relatives and friends at near real time, so that I don't have to worry about wasting the points any more. (C:13)
>
> The advertisements on the gift coupons are customized for targeted customers, which is more beneficial to the publicity of our enterprise and saves the cost of publicity. (C:14)
>
> My bank points usually take days or even weeks to be available for redemption, so that I sometimes forgot about them. What a loss! Now it seems faster and easier to use points, which saves my money and time. (C3)
>
> Before I always wondered whether my points would be eliminated by the merchants someday. Now I'm not afraid, because I know that the points are written into the blockchain as my asset and could not be altered if I do not agree since the records are tampered-proof. So I'll never need to worry about my loss anymore. (C:16)

Obviously, all of the four characteristics of the BubiChain-based LP application enhances customers' economy utility value by saving/earning money. Therefore, we propose:

Proposition 1. BubiChain-based loyalty program will enhance economic utility value of the customer with economic motivation when its point exchange is *multi-brands, peer-to-peer, real-time* and *secure*.

4.3.2. Towards satisfying the need of Autonomy

Customer's autonomy motives could be satisfied when he purchases under a specific goal that he sets on his own, achieves rewards by no certain due date, or has choices and options in choosing rewards (Deci, Connell, & Ryan, 1989). Primarily, customer perceives *psychological self-fulfillment* value when his need of *Autonomy* is satisfied (e.g. the LP helps me feel better about myself, I think I deserve to be rewarded for my purchases, I enjoy being a member of the LP, etc.) (Mimouni-Chaabane & Volle, 2010; Sweeney & Soutar, 2001).

The questions in this part were: "Do you want to have your own choices on BubiChain-based point platform? Has your goal been achieved?" If the answers were both positive, then the respondent was a customer with *autonomy* motivation, and his/her motive of autonomy was satisfied by the BubiChain-enabled point platform. At last we discussed about the question of "will you take part in the platform again?" to test their future participation behaviors.

As a result, 6 respondents were identified as the customers with autonomy motivation, since they claimed that they had the motivation of making their own choices, their need of *Autonomy* had been satisfied in the process of the point exchanging activities, and promised to participate again. We found that the *multi-brands exchange* characteristic affects the *Autonomy* motivation customer most, since about 83% of the respondents (5 out of 6) (C4, C10, C12, C15, C19) explained that the platform made it more convenient for them to redeem the points by their own decisions because they can exchange the points among various brands; then, 50% of the respondents (3 out of 6) (C5, C10, C19) noted that the blockchain application satisfied their need of using the points on their own since the transactions were tampered-proof and traceable which made the process more visible and controllable due to the *secure exchange* characteristic; finally, 1 of them (C4) focused on the near *real-time exchange* characteristic while another 1 of them (C15) emphasized the *peer-to-peer exchange* characteristic, both of which allowed them to have choices as a means of expressing themselves, consequently adding psychological self-fulfillment value to their decision of engaging the LP repeatedly. As depicted in the following coding map shown in Fig. 6:

Therefore, the BubiChain-enabled LP system, with flexible choices and options in choosing rewards and seamless exchange process across individuals, customer perceives a psychological value of self-fulfillment by feeling that his behavior is based on his own intention (Shi et al., 2014). We propose:

Proposition 2. The BubiChain-based loyalty program will enhance psychological self-fulfillment value of the customer with autonomy motivation when its point exchange is the *multi-brands*, *secure, peer-to-peer* and *real-time*.

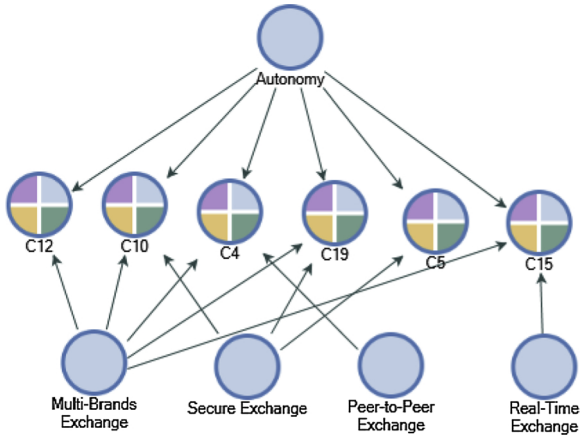

Fig. 6. Coding map of Autonomy motivation.

4.3.3. Towards satisfying the need of Competence

Customer's competence motives could be satisfied when he feels interested to engage in the loyalty program, feels being encouraged to achieve rewards, or has fun and surprise to engage in the loyalty program (Deci and Ryan, 1985; Ryan and Deci, 2002). Primarily, customer perceives *psychological self-fulfillment* value when his need for *Competence* is satisfied.

The question in this part were: "Do you want to make your efforts on BubiChain-based point platform? Has your goal been achieved?" If the answers were both positive, then the respondent was a customer with *competence* motivation, and his/her motive of competence was satisfied by the BubiChain-enabled point platform. At last we discussed about the question of "will you take part in the platform again?" to test their future participation behaviors.

As a result, 4 respondents were identified as the customers with competence motivation, since they claimed that they had the motivation of making efforts, their need of *Competence* had been satisfied in the process of the point exchanging activities, and promised to participate again. We found that the *multi-brands exchange* characteristic strongly affects the *Competence* motivation customer, since about 75% of them (3 out of 4) (C6, C7, C11) explained that the platform encouraged them to participate in the point exchange activities by not refining the target brands; then, 50% of them (2 out of 4) (C6, C7) noted that the blockchain application offered them much pleasure and fun since it was *real-time exchange* while the time cost of attaining the benefits was obviously reduced than before; finally, 1 of them (C11) focused on the *peer-to-peer exchange* characteristic while another 1 of them (C17) emphasized the *secure exchange* characteristic, both of which motivated them to engage in the point exchange activities under a specific goal (e.g. transferring points to a friend securely) and to make efforts for approaching the satisfied consequences.

The customer with a need for competence regularly pursues the rewards for fulfilling a desire or a goal. When he is motivated to make efforts for activity and his own behaviors turn to the cause of satisfied consequences, he represents a positive emotional response, such as feelings of pleasure or enjoyment (Zeithaml, 1988). Apparently, if a customer with competence motivation is satisfied by the reward options or transaction objects, he tends to perceive more value of psychological self-fulfillment. Besides, since the perceived value of fulfillment is defined as the balance between the perceived benefits and the perceived costs of attaining these benefits (Meyer-Waarden, 2013), a faster and easier system featured with real-time exchange really works. Therefore, we propose:

Proposition 3. The BubiChain-based loyalty program will enhance psychological self-fulfillment value of the customer with competence motivation when its point exchange is the *multi-brands*, *real-time*, *peer-to-peer* and *secure*.

4.3.4. Towards satisfying the need of Relatedness

Customer's motives of relatedness could be satisfied when he has opportunities to discover and join communities or has connections of interest and goals between peers and communities (Ryan & Deci, 2000; Shi et al., 2014). Primarily, a customer perceives *social interaction* value when his need for *Relatedness* is satisfied and can be derived from feelings of belonging to a community/like-minded peers or having a relationship with a brand or company (e.g. through the LP activities I can express my appreciation for the company or community, the LP has social benefits for me, etc.) (Kreis & Mafael, 2014).

The questions in this part were: "Do you want to interact with others on BubiChain-based point platform? Has your goal been achieved?" If the answers were both positive, then the respondent was a customer with *relatedness* motivation, and his/her motive of relatedness was satisfied by the BubiChain-enabled point platform. At last we discussed about the question of "will you take part in the platform again?" to test their future participation behaviors.

As a result, 4 respondents were identified as the customers with relatedness motivation, since they claimed that they had the motivation of interacting with other people, their need of *Relatedness* had been satisfied in the process of the point exchanging activities, and promised to participate again. We found that the *peer-to-peer exchange* characteristic strongly influences the *relatedness* motivation customer, since 100% of them (C8, C9. C18, C20) explained that the platform provide them with opportunities to join the surrounding community and make them feel more related, consequently perceiving the value of social interaction and intending to engage repeatedly; then, 75% of them (3 out of 4) (C9, C18, C20) emphasized that the characteristic of *secure exchange* motivated them to transfer points among individuals since the blockchain ensured the authenticity and verifiability of transactions through anonymity and they did not worry about their privacy; finally, 1 of them (C18) implied that the *multi-brands* point exchange encouraged him to contact the people with same interest or goals and thus obtain the feelings of belonging to like-minded peers or a community, consequently adding social interaction value to the decision of engaging the LP repeatedly.

The need for relatedness means feeling connected to peers. For a consumer with relatedness needs, the LP that allows point exchanges across individuals with reciprocal goals and demands while protecting personal privacy and ensuring transaction authenticity, can act as a powerful facilitator for the creation of social interaction value. Therefore, we propose:

Proposition 4. The BubiChain-based loyalty program will enhance social interaction value of the customer with relatedness motivation when its point exchange is *peer-to-peer, secure* and *multi-brands*.

To summarize, key technique resources of BubiChain convert to blockchain-based natures that revolutionize the loyalty point exchange process and act as facilitators for the creation of value. Specifically, while BubiChain and its applications influence the motives for LP participation, perceived value that relates to a certain motive embodies the assessment of the utility of loyalty point activities to satisfy the need. It is emphasized that motivations and value perception categories in LP context are deduced from literature, while key techniques and natures of BubiChain-based loyalty point exchange natures are extracted and confirmed by empirical research, as shown in Fig. 7.

5. Implications for practice

Our findings provide some essential managerial implications to the design of existing blockchain mechanisms and LP schemes. In the LP context, the blockchain service providers should develop a permissioned blockchain that only allows the explicitly authorized members to be a part of it. Within the system, the point exchange transactions are recorded and kept in the blockchain, which are only available to consortium merchants and membership customers, while the real identities of all users are known in order to reduce the likelihood of fraud behaviors. Hence, consensus protocols such as PBFT instead of PoW (Proof of Work) can be used, which ensure that information sharing is controlled well among the verified nodes. Speed, security, and scalability are far better in the permissioned blockchains compared to the public ones (Natoli & Gramoli, 2016, 2017), which are examined to be important to LP users in our study. Mastering the core technologies of blockchain is the key to successful development in the blockchain project. Blockchain providers should learn and devise the design and implementation of blockchain-based LP projects, and guide shopping malls and enterprises to increase research and development eff ;orts in this field. Both of them need to carefully consider how to adapt the features of blockchain technology to the current LP service portfolios.

In addition, enterprises should recognize that the assets attribute of loyalty points is the main factor that aff ;ects the long-term LP development. The success of a LP project mainly depends on whether it can provide its users with multi-brands exchange services, while secure,

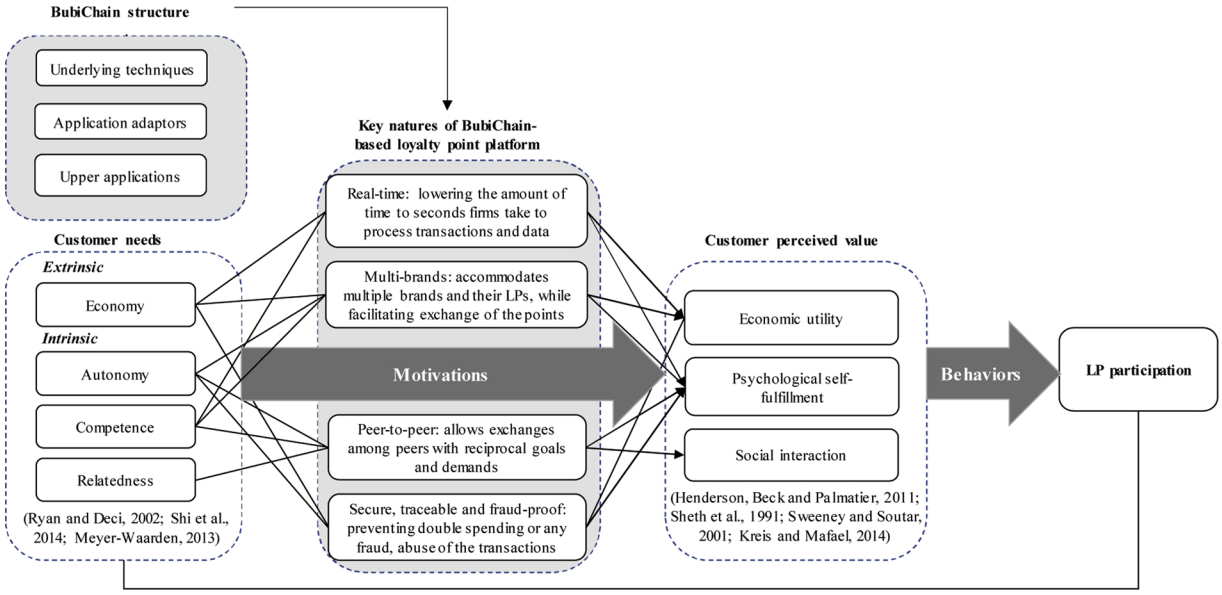

Fig. 7. Overview of the effects of BubiChain on LP participation.

peer-to-peer, and real-time exchange services also value a lot for some targeted customers. Since loyalty points program is considered as an economic incentive, which enhances customer experiences and purchase retentions, managers should adopt advanced IT applications to improve its effectiveness and enhance users' enthusiasm for participation. Loyalty points are supposed to be used by customers' personal preferences and motivations as assets, rather than reliabilities in terms of future rewards or deferred rebates. Enterprise managers should focus on introducing blockchain mechanisms to solve the problem of trust and privacy, which will lead to the efficient exchange of loyalty points among organizations and individuals.

Finally, this research, based on the successful application of BubiChain-based point exchange platform, verifies the applicability of blockchain technology in industrial environments other than cryptocurrency, while additional efforts have to be made in building larger-scale permissioned blockchain systems with appropriate standards and benchmarks to evaluate their performance (Mohan, 2019).

6. Limitations, conclusions, and future work

In this study, we explored the relationship of customer motivation and perceived value moderated by blockchain-enabled LP design. This study is an early attempt to analyze the blockchain impacts on LP, as it establishes a theoretical framework to explain the effect of blockchain in loyalty point participative behaviors. Our research is guided by solving the problem of customers becoming less interested in loyalty points exchange activities, while existing research found that the primary reason was their personal preferences and motivations not being satisfied in the current LP schemes. We try to explain whether the blockchain-enabled LP scheme, which was emerging in the recent years, can enhance customers' participative behaviors through meeting their motivations that drive their participation in LPs. We apply the self-determination theory for defining the needs for the economy, autonomy, competence, and relatedness, while the perceived value is categorized into three dimensions: economic utility, psychological self-fulfillment, and social interaction. In a conceptual model, we explain the cause-effect of blockchain application on the relationship of varying customer motivations and the corresponding perceived value. An exploratory case study on BubiChain platform for loyalty point management was adopted to scientifically prove that, while previous loyalty points scheme can only act as an economic incentive tool, the blockchain-enabled loyalty point platform is able to satisfy customers' multi-dimensioned motives due to its revolutionized features. Blockchain application can process and confirm transactions and data in a peer-to-peer network at near real-time while assuring tamper-resistant, giving rise to a tokenized economic system, which is able to enhance the feasibility and fungibility of digital assets by making it easier and faster for customers to access and consume.

There are a few inevitable limitations: first, our theoretical framework still needs to be improved. We adopted SDT as the theoretical foundation but did not achieve a breakthrough on this theory, and the relationship between key techniques of blockchain and the key natures of blockchain-based loyalty point scheme remains relatively vague. Future research needs to explore more new perspectives on the theoretical model; second, LP as an institutionalized incentive system itself could not directly lead to loyalty behaviors (Henderson et al., 2011). Future research needs to continue to explore the complicated relationships among blockchain-based LP design, LP engagement, and customer loyalty behaviors (e.g., purchase retention, word of mouth, etc.); third, this study used only one case to examine the conceptual model. Since different blockchain systems have quite different mechanism designs, the structure of the BubiChain-based loyalty point exchange platform may not be able to represent any other system. More cases and comparisons are expected to verify the reliability of the proposed model. Future studies are expected to employ multiple cases with various industries and regions to measure the impacts of blockchain on LP participation more comprehensively; finally, blockchain could entail high risks due to the potential problems including data portability, key securities or user collision and control. Besides, one of the key characteristics of blockchain is redundancy, while all the points would be exchanged on a private-permission blockchain and consequently all the transactions' data will be saved immutably and redundantly in the entire hardware ecosystems, which might negatively impact the operation success of most cases. Future studies also need to explore failure cases and prove blockchain's application on a larger scale.

Acknowledgement

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Appendix A. Bubi documents

- The design and implementation of BubiChain's Gege Point Platform (2016): internal document
- An introduction of BubiChain's architecture and BaaS offerings (2016): internal document
- A review of Gege Point Platform and BaaS services (2017): internal document
- Bubi Journal, No. 1, February (2015): internally published journal
- Bubi Journal, No.2, August (2016): internally published journal
- Bubi Journal, No. 3, February (2017): internally published journal
- Bubi Journal, No. 4, October (2018): internally published journal
- BubiChain Product white paper (2016): white paper
- A review of Shu Bei Wallet System and BaaS services (2017): internal document
- The design and implementation of Shu Bei Wallet System Platform (2017): internal document

Appendix B. Articles on Bubi webpages

- "Luxury gift" online! Suning LP card is launched on the BubiChain (2017), (https://bbs.bumeng.cn/portal.php?mod=view&aid=256, accessed on 19th of December 2017)
- "Ju Fen Bao" points online: BubiChain to have a new member! (2017), (https://bbs.bumeng.cn/portal.php?mod=view&aid=175, accessed on 5th of May 2017)
- Loyyal has used the blockchain to help Dubai and Norway's tourism industry exchange points (2016), (https://bbs.bumeng.cn/portal.php?mod=view&aid=68, accessed on 1st of November 2016)
- BubiChain-based digital assets platform is officially launched: open to break barriers (2016) (https://bbs.bumeng.cn/portal.php?mod=view&aid=29, accessed on 12th of August 2016)

Appendix C. News articles

- Bubi blockchain to build a new asset circulation system: Gege Point Platform online (2016), (http://news.sina.com.cn/o/2016-04-27/doc-ifxrtvtp1373304.shtml, accessed on 27th of April 2016)
- Current status of domestic blockchain projects: Shubei Wallet and Gege points (2016), (https://www.chainnode.com/post/33286, accessed on 16th of May 2016)
- Bubi blockchain LP application "Shu Bei Wallet" is landing (2016), (https://www.sohu.com/a/64128447_241812, accessed on 18th of March 2016)
- A conversation with Bubi' partner & CTO Jun Li: applying blockchain technology to promote single center to multi-center to reduce credit friction (2017), (https://www.jinse.com/news/blockchain/62257.html, accessed on 31 st of August 2017)
- Bubi completed A round of financing of 100 million RMB, realizing the commercial value of "supply chain finance + digital economy" (2018), (http://www.sohu.com/a/225007308_328817, accessed on 7th of March 2018)
- BubiChain-enabled digital assets platform online: Sunshine Insurance, Qian Xiang Finance and Shubei Wallet have joined (2016), (https://www.8btc.com/article/99830, accessed on 11 st of August 2016)
- It's no longer a concept! BubiChain-enabled insurance card in China was officially launched (2016), http://www.sohu.com/a/108579197_379963, accessed on 1 st of August 2016)
- Take a look at some of the hottest blockchain application companies in China (2017), (https://www.chainnode.com/post/87659, accessed on 1 st of November 2017)
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