Inf Syst Front
DOI 10.1007/s10796-015-9604-z

Enhancing service system design: An entity interaction pattern approach

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Abstract The notion of system thinking and the Industrial Marketing and Purchasing Group (IMP)'s findings have been emphasizing that "interaction is the basis analysis unit" of service systems or enterprises. Service system design is an attempt to change the outcome of a service ecosystem and make it more innovative in terms of figuring out not only who those entities are and what their outcomes are, but more importantly how they interact to realize their service values. The design of a service system could accordingly be viewed as changes made to the interactions. In the paper, system entity interactions are classified into patterns to become more analyzable, and different patterns can serve as measurements and guidelines for enterprises to follow and use to gain higher service value. To justify the important role of interaction in the service value creating process, a particular information system is developed and evaluated to explore the benefits of using interaction patterns for enterprise users to create their service values.

Keywords Service system design · System thinking · Interaction pattern · Alliance strategy · Service innovation

1 Introduction

In the era of the information economy, the share of service industries against the total GNP has an increasing trend, and the share of the secondary information sector has also been increasing. This implies that these increases can be partially ascribed to the growth of the information components of service industries (Apte and Nath 2000, 2008). A service can be regarded as a socio-technical system (Bostrom and Heinen 1997) that is a system composed of technical and social subsystems. An example for this is a hospital where people are organized, e.g., in social systems like teams or departments, to do tasks for which they use technical systems like information systems (or other machines like x-ray machines). In other words, a service system is made up of jointly independent but correlative interacting systems (social and technical), and system designers conceptualize a service system as a set of complementary or interdependent subsystems comprising information components with the objective of jointly optimizing both the social and technical subsystems.

However, most previous studies of service systems have been fairly descriptive (i.e., concerning more on the "what" aspect) and explanatory works focusing on "why" and "how" to design service systems are still lacking (especially for complex service systems). To this end, the factors to consider can include strategies, development and execution (Ostrom et al. 2010). However, we argue that enhancing the design of service systems considering important information components should also be regarded as one of the core required activities.

Designing a service system is a process aiming to create new or improved (existing) services to make them more useful, usable and desirable for customers or clients, resulting in a variety forms of service innovation. Most existing service design methods (Brown 2008) (Flies and Kleinaltenkamp 2004) place more emphasis on customer-centric and behavioral aspects. However, Aronson (1997) addressed that a service is created during interactions between actors under governing mechanisms. Vargo and Lusch (2004) addressed the theory of

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Published online: 26 October 2015

Service Dominant Logic, pointing out that service resources like alliance partners and end customers are operant resources and can be influenced by each other and influence other resources to co-create value. Demirkan (2011) further explained how a service system's final outcome (i.e., service value) is produced and decided by the interactions between entities (i.e., a set of system entities that interact to produce the goal behavior as addressed in the concept of system thinking). As depicted in Fig. 1, an entity in a service system could be considered as an actor who can have actions influencing others, and interactions have to do with how multiple entities work together and the outcomes are created during the interactions.

This is connected to service system design where the focus should be placed on the interactions between multiple actors to create value for interacting parties. Accordingly, service system design is to figure out not only who those entities are and what their outcomes are, but more importantly how they can interact that could be regarded as the new important information components for service systems. Changing the interactions of entities can also alter the final service outcomes. For example, Apple's iPod is changing the way a Mp3 player manufacturer interacts with its customers - from product provider to a music service facilitator; Dell's up-to-build service is actually altering the density and purposes of customers' interactions with the company, and it also changes the interaction between Dell and the equipment manufacturer. This breeds the concept of the possibility of carrying out service system design by manipulating interaction.

After understanding the importance of interaction, this study uses interaction pattern as our chosen perspective to find new service system design approaches that can lead to service innovations. The purpose of this study is to enable enterprises to do service system design by themselves. Our method is to provide a self-service service system design supporting service, which is able to collect information from the enterprise users and then analyze and generate corresponding service system design hints and guidance based on changing the alliancing condition by adjusting current interaction patterns. That is, this study is to solve how to generate adequate service system design recommendations based on system thinking for enterprises to reference the recommendations by themselves with ease. Our method is a design science approach that is focused on the building and evaluation of an artifact (i.e., our system) designed to meet identified business needs (Hevner et al. 2004) (Gregor and Hevner 2013) as the aforementioned.

The aims of the study accordingly are three folds: (1) Investigate the effectiveness of using interaction pattern as our chosen perspective for designing a service system. (2) Develop a service system design approach based on the interaction-centric notion with easy-to-adopt features for businesses. (3) Implement a prototype information system to demonstrate the utility of the approach.

The remainder of this paper is organized as follows. Section 2 examines previous studies about interaction. Section 3 presents the basic concepts of our approach that is further detailed in Section 4. Section 5 provides the experiments and the evaluations. A discussion and the conclusion are then provided in Section 6 and 7 respectively.

2 Literature review

2.1 IMP interaction model

For previous research using interaction as a foundation for business, the Industrial Marketing and Purchasing Group

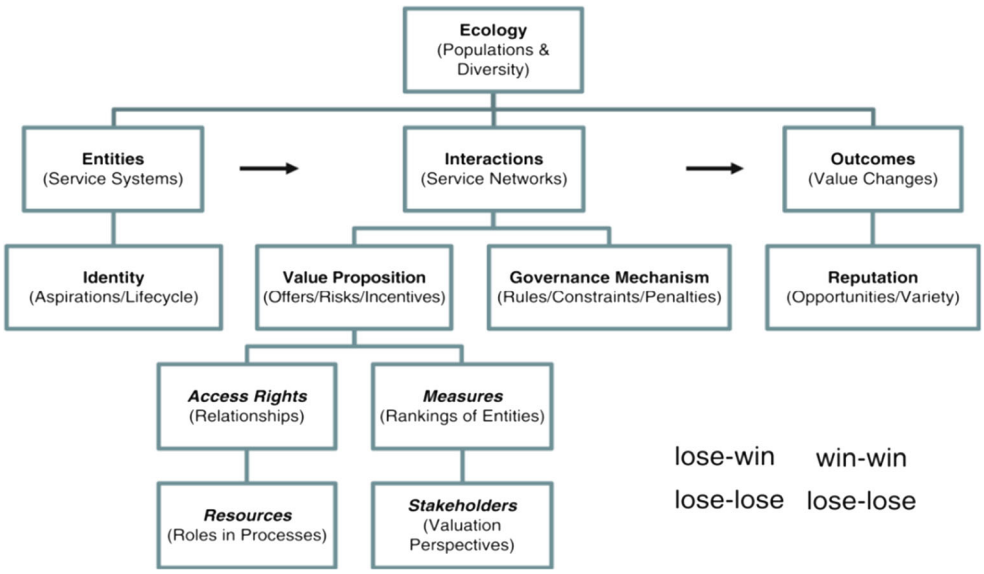


Fig. 1 Key elements of a service system (Source from Demirkan et al. 2011)

(IMP) performed intensive interaction-related studies for years. The IMP has argued that interaction is the core of the research of relationships and networks in business markets, because it is the basis of business transactions and the smallest analytical unit (Håkansson 1982; Snehota and Håkansson 1995; Naude and Turnbell 1998). This section aims at providing an overview of these prior theories or knowledge related to the interaction-related studies.

One of the key studies of the IMP group about interaction was done by Håkansson (1982). Håkansson provided an interaction model in which the interaction of a business should be considered under a more macro scope separating interactions into four components: the interaction process, interaction parties, interaction environment, and interaction atmosphere (Fig. 2).

The interaction process can be divided into short term and long term; the short term process is the actual exchanging process that happens between businesses, and the long term process is the aggregation of the relationship which builds within the exchanging process. The interaction parties are the businesses that are involved in the interactions, which are related to organizations and individuals, where an organization is the company itself, and the individual usually refers to the person that interacts with another company's representative. The environment where the interaction is taking place is a business environment, where the structure of the market and the dynamism, internationalization, position and social system are taken into consideration. The environment includes the outcomes of businesses within the same industry, society, and government. The interaction atmosphere refers to the surroundings of all the interactions that businesses have.

The atmosphere can be considered in terms of power dependence, cooperation, closeness, and expectations. All the factors within the atmosphere are affected by the environment, parties, the process of the interaction, and the effects of these various factors on each other. Atmosphere is built through time, and is a dynamic factor that is changing and influencing the overall interaction conditions all the time.

In addition, the atmosphere should not be excluded owing to industry dependence (Spencer and Sutton-Brady 1996). The atmosphere is a long-term variability of interaction which is influencing and influenced by the interactions; the atmosphere surrounds the interacting entities and affects the process that the interacting entities are taking; also, the outcome of the process will influence the atmosphere of the interaction (Håkansson 1982). Due to the long-term nature of the atmosphere, we argue that using atmosphere in characterizing interaction patterns can reflect the conditions of the interactions.

Although the IMP group has done much research on interaction, according to another IMP study (Woo and Ennew 2004), the constructs of interaction atmosphere are not unshakeable. Young and Wilkinson (1997) have argued that the construct of atmosphere includes a great diversity of research related to business relationship management, but the heart of the atmosphere actually is the competitiveness and cooperativeness of a business, and also the trust between alliance partners. Consequently, it is necessary to examine how every construct within the atmosphere, including power dependency, cooperation, closeness and expectations, should be appropriately reinterpreted.

Power dependency is about the degree that one company is able to influence its partner, and also whether one company is able to survive with or without another company's existence (Håkansson 1982). The measurement of power dependence includes customer preference, completeness of line, sales, human resources, brand image, and accessibility to market information (El-Ansary and Stern 1972), which can be related with the competitiveness of a business. Accordingly, we argue that power dependency is appropriate to serve as a construct of interaction atmosphere.

The closeness of companies is another construct of the atmosphere; however, as mentioned by Håkansson, closeness is a construct that a company must manage well in their

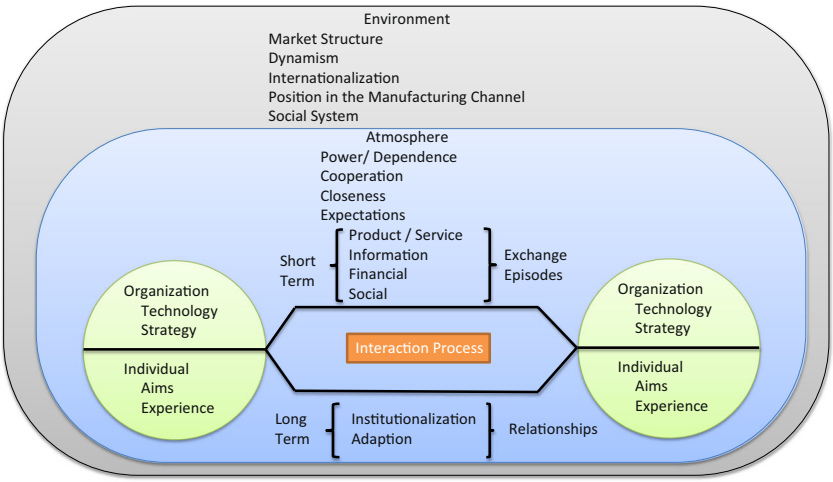


Fig. 2 Illustration of the interaction model (Sources from Håkansson 1982)

interaction. Being too close or indifferent are both undesirable interaction conditions, which is quite different from the power dependence construct where the lower dependence is the better. On the other hand, the high closeness of a company with another company often results in high power dependence (Turnbull et al. 1996). Håkansson agreed that the closeness of two partners reflects the degree of a company's power dependence. Another argument of closeness comes from Laing and Lian (2005). They stated that the closeness of companies is the basis of trust—when companies are very close, the level of trust or the ease of forming trust is usually higher than that with other companies. Since closeness crosses both trust and power dependence, which refers to the competitiveness of the atmosphere, we argue that instead of keeping closeness, it is simple to consider just the power dependence construct, and add the trust construct into atmosphere measurement.

The remaining constructs are cooperation and expectations. The construct of cooperation refers to the compatibility of two companies and their ability and willingness to cooperate (Håkansson 1982), which is similar to what Young and Wilkinson (1997) have argued; so it unquestionably fits as one of the revised atmosphere constructs. Meanwhile, the importance of expectations has been agreed upon by many business related studies. Research had shown that ability expectations and outcome expectations of companies are decisive factors when starting a new venture (Townsend and Busenitz 2009). Marketing research has put emphasis on managing customer's expectations for years (Gronroos 2008; Parasuraman et al. 1998), and business alliance related research has also devoted efforts to discovering how to manage expectations (Ariño and Ring 2010; Barney 1986; Royer and Roland 2009). Moreover, a value proposition of another company could be also considered as forming the expectation of the exchanger; accordingly, expectations serve as an important factor, just as important as other constructs. Concluding, we suggest that all the constructs involves in an interaction's atmosphere could be taken into consideration in the interaction between two companies.

However, even though the IMP interaction model well describes interaction, some statements have been made opposing to their research. One of the arguments has to do with the level of complexity of the IMP interaction model. An IMP group study done by O'Farrell and Moffat (1991) applied the IMP interaction model as the basis of their research, but pointed out the complexity of the IMP interaction model. Accordingly, Håkansson and David (2002) indicated that interaction patterns are important to tackle the complexity and under some business marketing strategies businesses tend to aggregate interactive choices into specific interaction patterns. However, Wynstra et al. (2006) stated that no large scale efforts were undertaken to investigate the interaction patterns around service, and addressed this to be a gap that needs to be fulfilled.

2.2 Interaction pattern

An interaction pattern is the outcome of pattern recognition, which is a process where a specific individual tries to understand complicated and unrelated—like events as identifiable patterns of behavior (Matlin 2002). The pattern approach has been widely used in many fields, like computer science, human interaction, psychology and physiology, business, artificial intelligence, and social sciences (Hannemann and Kiczales 2002; Stark et al. 1962; Fehr 2004; Hemelrijk 1990; Barros et al. 2005; Fukunaga 1990). However, not much interaction pattern related research can be found, and most existing research only states that interaction has patterns (Halinen 1997; Turnbull et al. 1996; Håkansson and David 2002; Woo and Ennew 2004). One study that has addressed interaction patterns was done by Wynstra et al. (2006).

In Wynstra et al's research, they defined interaction patterns in terms of different service types, including component, semi-manufactured, instrumental, and consumption. Each interaction pattern stands for a specific type of service that a supplier provides to its customer. For example, a supplier might not actually make components for its customers; however, the way they serve their customer fits the component service type of interaction pattern; so the supplier and customer are having the component type of interaction pattern. Different patterns have different objectives, capability requirements of supplier and customer, representatives of supplier and customer, and Table 1 highlights their works. Wynstra et al's study provides a good example of how interaction patterns work for businesses and how to study them. However, we argue that service systems not only have buyer and supplier entities, but also have other related entities. Moreover, these entities should be well interpreted to better understand how each interaction pattern is created.

In addition, a concern of Wynstra et al's research is that the content of the interaction patterns they defined actually took very little from the IMP interaction model. One of the reasons that the IMP interaction model is less involved in their research is that the three elements of the IMP interaction model (process, parties, and environment) are closely related to the specialty of a specific industry. Involving the IMP interaction model too much might have jeopardized their research without loss of generalities. However, the IMP interaction model is still a great analytical framework for interaction research especially for the construction of interaction patterns.

2.3 Service system & alliance

In a service system, the final outcome of value is co-developed by entities (Spohrer, et al. 2011). Applying this concept to an alliance, this means the value of the alliance is created by multiple sides. Taking the supply chain perspective into alliance, more than supplier and customer entities exist among

Table 1 Propositions on objectives, capabilities and interfaces for different service types (Source from Wynstra et al. 2006))

Type of service	Objectives	Critical supplier capabilities	Critical customer capabilities	Supplier representatives	Customer representatives
Component services	The service should fit with the customer's final offering	Production capacity and quality Development capabilities (in case of specialized services)	Translating/communicating final customer demands (on ongoing basis) Synchronizing the supply of various service components	Marketing representatives regarding the supplier's own service "downstream" specialists (knowledgeable of the customer final offering)	Buyer specialists regarding the service bought, and marketing representatives knowing the needs of the buyer's customer
Semi-manufactured services	The buying company should be able to transform the service in desired way	Production capacity and capability to maintain a stable quality Innovative capabilities (when used as an external expert and for strategic services)	Translating final customer demands Optimizing fit between internal and supplier's operations Synchronizing suitable contact interfaces between internal and the supplier's operations	"Production planning" and marketing and marketing representatives	Production and quality representatives
Instrumental services	The service should affect the customer's primary processes in the desired way The service should fit with important characteristics of these primary processes	Business development and innovation Business and service production design services	"Implementation" skills; understanding what fits when, how and for whom	Product representatives often including a team of consultants or process engineers	Business development representatives and affected internal customers
Consumption services	The service should support various core processes	Ability to supply the desired service and (if needed) adapt it to the specific situation of customer	Translating/communicating internal customer demands (ongoing basis) Follow up on performance and user satisfaction	Marketing representatives	Buyer and internal customers

these vertical entities. Other organizations also exist, like competitors and non-competitors that need to be collaborated with to create value (Simatupang et al. 2002).

In the meanwhile, an alliance might not only occur only as a one-to-one type. The concept of alliance constellation has also been proposed. That is, a company will form alliances with multiple companies to compete with other similar groups of companies (Gomes-Casseres 1997). The advantages of an alliance are obvious, as are the advantages of alliances with more than one company. The benefits of alliance constellations have been classified into five items (Gomes-Casseres 2003): linking to market, combining skills, building market momentum, reducing costs, sharing risks. The "combining skills" advantage has been said to be able to create a new business or compatibility for an alliance. According to Juttner et. al (2007), to become a market winner a company should have advantages on both the marketing and supply chain. This can refer to the concept that constellations build strong supply chains through multiple companies, and have strong linkages with the downstream market-closer companies. This could create advantages for companies within the industry. Leenders and Wierenga (2002) stated that integrating marketing forces and R&D capability is a major concern of companies that wish to have excellent new product development. This also adheres to the concept that for companies with strong supply chains for products or services, forming an alliance with a proper marketer and R&D facilities is a great choice. That is, enterprises have much more alliance choices and combinations that need to be considered besides the service types that only take into account the customer-supplier relationship of interaction patterns as mentioned by Wynstra et al.

Summarizing the previous discussions, we have two arguments. Distinguishing from the Wynstra et al's findings, our first argument is that interaction patterns in alliance relationships should be more than only a one-to-one, customer-supplier relation; instead, patterns should involve lateral companies, and multiple-to-multiple relations. Our second argument is that the IMP interaction model should have more proper reinterpretations as the aforementioned about the four constructs of interaction patterns (power dependence, cooperation, trust and expectations). In addition, the four constructs (power dependence, cooperation, trust, and expectations) have levels (Laing and Lian 2005; Johnson et al. 1996; Chatman and Barsade 1995), the interaction patterns applying these four constructs can accordingly be classified into different levels of patterns.

In this study, the analysis of interaction patterns will consider the categorization of the roles of the entities they are partnering with, which are customer, supplier, and lateral entities. The customer and supplier entity are defined in a broader sense to cover a wide range of various industries. The customer entity is defined as both customers and all the

entities that could help link an enterprise with its current customers or bridge connections with new customers. The supplier entity is defined as both material suppliers and all the entities that hold the key resources or knowledge which can improve an enterprise's current products or service quality. For simplicity, we will refer to these entities as customer and supplier in the following sections.

In addition, the original interaction patterns (Wynstra et al. 2006) provide only the best interaction pattern of a specific service type that can achieve a business direction to which managers can refer. However, we suggest that it will be more useful for managers if there are more different levels of patterns with which to compare and assess their company's status. By taking more patterns into account, the usability of the interaction model can be extended from a directing-only function to a broader analysis tool which is able to evaluate current conditions and provide guidance to enterprises.

With this extended usage of the interaction model, we position this study as an attempt to devising an entity interaction approach for service system design to address the following interaction related issues: (1) Existing service system design tools should consider more about the interaction of the entities within the service system based on the perspective of interactions. (2) Alliance with other enterprises is one of the best ways for an enterprise to create innovation since enterprises might lack innovation-necessary resources. (3) The key of innovating through alliances is to well manage interactions. (4) Interactions can be classified into patterns to become more analyzable, and different patterns can serve as measurements and guidelines for enterprises to follow and use to gain higher service value.

3 Entity interaction pattern approach for service system design

For design science, an artifact can be either science (analytical) or engineering (synthetic). Once synthesized, an artifact can be characterized in terms of its functions, goals, and adaptability. Design science in information systems research has seven guidelines (Hevner et al. 2004): (1) research question (2) design as an artifact (3) design as a search (4) research rigor (5) & (6) design evaluation and application utility (7) research contributions and impacts. Section 1 has addressed our research question in relation to the relevant business problem. This section mainly describes the description of the search and the design of our artifact. The details of the artifact are then provided in Section 4. The design evaluations will be provided in Section 5. Section 5 & 6 also address research rigor on the construction and evaluation of the design artifact. The research contribution and impacts are then discussed in Section 6.

3.1 Basic concept

This study aims to create a service system design approach for enterprises to use, which focuses on important concepts ignored in previous research (i.e., the interaction patterns within alliance partners). The proposed approach provides enterprise users with a way to create their own capabilities through innovation and survive in the competing market.

With the discussion of the interaction related knowledge in Section 2, this study explores reinventing the interaction patterns from Wynstra et al's research (Wynstra et al. 2006). Firstly, their way of service type categorization is analyzed to attain the interaction roles of the alliance entities including supplier, customer and lateral entities. Secondly, the interaction pattern to which an enterprise belongs can be characterized and measured by the four constructs from the extended interpretations of the interaction atmosphere of IMP's interaction model (power dependency, cooperation, trust and expectations). Lastly, the interaction pattern classification is simplified into three levels of interaction patterns. That is, a company can have three levels of interaction patterns (worst, average, and best) with three roles of alliance partners (customer, supplier, and lateral entities).

Since the interaction patterns applying the four constructs (power dependence, cooperation, trust, and expectations) have levels, they can be classified into different levels of patterns as mentioned in Section 2. Low power dependence, cooperation, trust, expectation refers to worse interaction with an alliance partner, indicating a need for improvement. High power dependence, cooperation, trust, and expectations correspond to a better condition of interaction. A lack of levels makes it hard for enterprises to assess their current pattern. However, excessive levels also lead to diffusion. For simplicity, in this study we adopt 3 levels of interaction patterns, worst, average, and best, for the different performances of the four constructs, as depicted in Fig. 3.

This interaction pattern classification can support alliance management in service system design, and further provide us with the foundations to move on to an interaction pattern

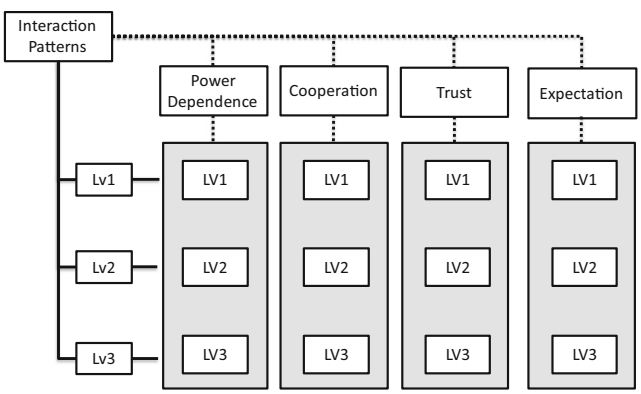


Fig. 3 Interaction patterns and constructs mapping diagram

based service system design approach. In Section 3.2, we further describe how interaction pattern could be managed by different constructs, and how manipulating of interaction pattern leads to service innovation.

3.2 Entity interaction pattern approach

The purpose of this study is to develop a service system design approach based on the interaction-centric notion with easy-to-adopt features for businesses. The approach's information system architecture is presented as follows in Fig. 4.

At the beginning of the service, the enterprise users will start from the Data Collection Module, which will abstract data that are required for recognizing the interaction pattern. Then the system will pass down the interaction information it collected to the Interaction Pattern Recognizing Module to analyze the user's interaction condition with other entities within its service system. This is followed by moving to pattern recognition. Users are also involved in the process, because after the interaction pattern is recognized, the system will display the explanations and examples of the pattern to make sure the user is really classified into this pattern. If any gap exists between the analyzed results and the real world situation, adjustment will be performed accordingly.

After the interaction pattern is recognized, the next step is the adjusting module. In the Interaction Pattern Adjusting Module, the system provides two ways for users to come up with an improvement goal—bottom-up or top-down. Users can input their desired situation into the system to see what kind of recommendations come out; or try to test for different kinds of interaction situations from scratch, find out what each one leads to and then choose the most appropriate. There might be some painful points for users in this module, such as confusion about what step should go next and what result a step will bring. Accordingly, the third component within this module is a recommendation system which leads users through the process and provides advice. The final outcome of the adjusting module is a desired interaction pattern for a good alliance condition to enable service system value co-creation, and the implementation route from the current situation to desired one.

Through the Interaction Pattern Recognizing Module and the Interaction Pattern Adjusting Module, an enterprise user will be able to create an interaction pattern based service system design direction to work on. The output of the adjusting module is passed to Alliance Adjustment Guiding Module, of which the key components include the business case database and the guidance system. The business case database contains several cases of business under particular circumstances by which some efforts to change the interaction situation with fellow partners or other entities within the service system can achieve the desire outcome. The guiding module references the data it receives to the case database, and selects the most appropriate one for the enterprise user; also it displays and points out the key success factor of the case for the enterprise user to refer to during their own implementation work.

Through this information system, we hope to provide enterprises with a self-service approach to generate good service system design hints. The following subsections elaborate upon the details of these modules and the underlying concepts behind them.

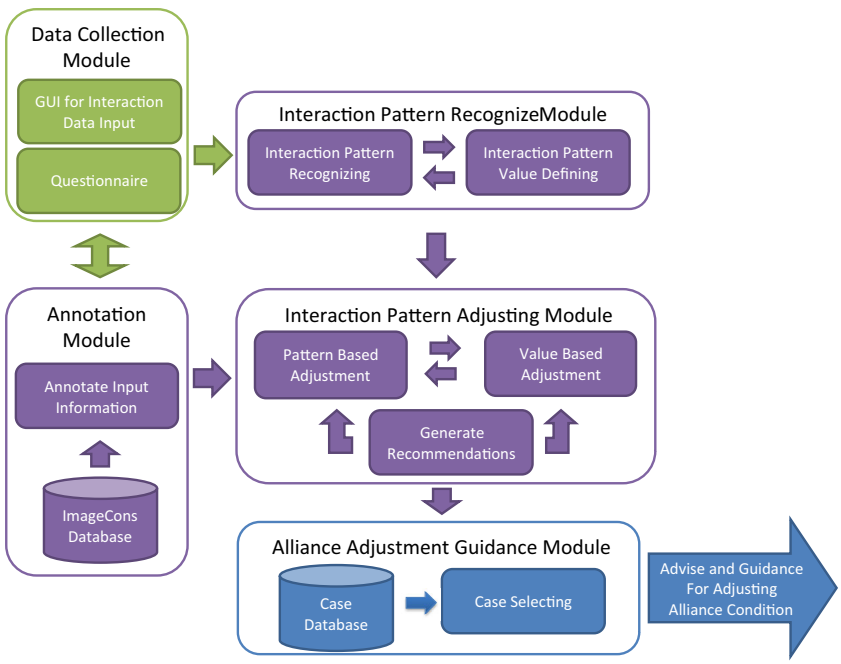


Fig. 4 The approach's information system architecture

4 The details of the approach's modules

4.1 Data collection module

To enable the self-service system and for better output quality, the data collection work must be done with great precision to eliminate the need for human intervention afterwards. As defined in Section 2, there are four main constructs of interaction which also serve as the foundation of the interaction pattern, including expectation, trust, cooperation, and power dependency. The questionnaire used in this system should be able to capture enterprise user's performance data in relation to these constructs. This study uses a questionnaire as presented in Table 2 for data collection. For the Cooperation and Trust constructs, we adopt questionnaires from previous works by other researchers, while for the Power Dependency construct the questions-to-ask are defined by this study based on the definition of Power Dependency as stated in Section 2.

For the Expectation construct, this study does not ask particular questions about expectations by assuming that the attained details of trust, cooperation and power dependency are in fact the expectations of trust, cooperation and power dependency which one enterprise has of another enterprise. That is, we incorporate the idea of expectations into trust, cooperation and power dependency and merge the idea into each question in the questionnaire.

However, this questionnaire requires enterprise users to provide answers for each entity it is interacting with, for example, if there are ten entities the enterprise user is interacting with, then the questionnaire must be filled out ten times. This might make the input work too lengthy and annoying for enterprise users. We can solve this problem by re-designing the input method of the questionnaire; instead of answering eight questions for each interacting entity, we minimize the input work to one data input action for each interacting entity. Figure 5 presents the idea behind this design. The circles mean the levels of cooperation; that is, the closer to the circle, the higher the cooperation between the user and the entity. The size of the rectangle represents the power dependency of the user and the entity; the bigger the rectangle, the higher of the dependence of the user to the entity. The last one is the construct of trust, which we use color to represent; if the rectangle is red, it means the trust between the user and entity is low, while blue represents average and green is for good. Also, according to the definition we made after comparing previous studies of alliance, the entity's role in the service system is important. Thus, this role must be known to do further analysis. We can design the input method as a map-like graph; different positions of the entity the map refers to different roles it serves in the service system.

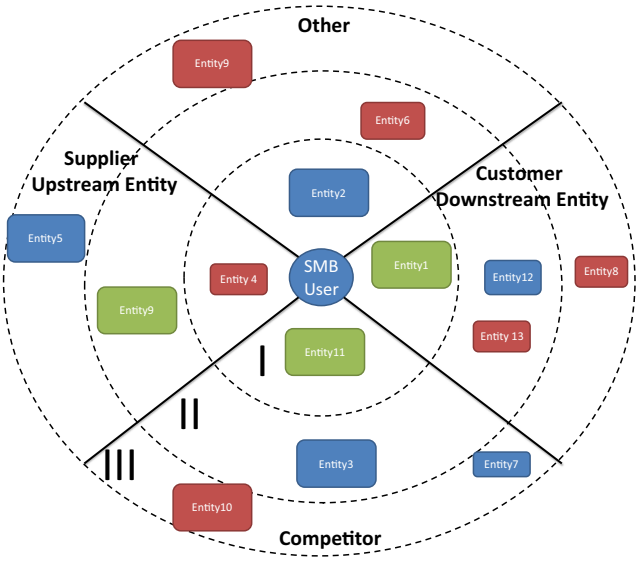


Fig. 5 Data collection as building a map-like graph by positioning each interacting entity within the map graph representing its role in the service system

However, there exists a gap. Each construct has two to three questions in the questionnaire, but the enterprise user can only fill in each construct with one answer as presented in the above example. For example, there are three questions in the cooperation construct, but we only use the distance between the entity and the enterprise user to represent the construct. Thus, a transformation is required.

The purpose of the questionnaire is to extract the interaction conditions of the enterprise with other entities, and this information is going to be used to recognize the interaction pattern. Consequently, how the recognizing system does the analysis will influence the data collection. Before we introduce the transformation, we need to introduce the interaction pattern first.

Table 2 Questionnaire details

Cooperation (Source: Frear and Metcalf 1988; Metcalf et al. 1992).	The level of process-cooperation of the entity The level of the entity can respond to the requirement or solve the complaints The level of cooperation of the actor during conflict
Trust (Johnson et al. 2000)	The level of credibility trust The level of Benevolent Trust
Power dependency (Sorted by us)	The level of importance of this entity The level of involvement of this entity in SME's process The level of irreplaceability of the entity

In this study, we assume that there shall be a superior interaction pattern with another entity when, under most circumstances, the enterprise users seek to have a relationship that is good and trustable. We also assume that the enterprise has great influence on the entity. On the other hand, an interaction pattern that is least favorable for an enterprise with another entity exists within the system. There also exist an interaction pattern which is the most unwanted and dominating pattern. For simplicity, we use numbers to refer to these interaction patterns. Hence, we have interaction pattern level 1 for the worst interaction patterns for creating value from an alliance, interaction pattern level 2 in the middle as an average, and interaction pattern level 3 for the most welcome. Interaction pattern level 3 requires that all the three constructs have good performance. If any one of the construct performs badly, it will drop to an inferior level. Figure 6 depicts the evaluation process and Table 3 explains the rationale.

To fit the interaction pattern level's classification, the constructs shall also be evaluated in the same way. That is, there are three levels of interaction patterns and the constructs also have three levels corresponding to them, which are high, medium, and low. Hence, the way to evaluate the result of the questionnaire corresponds to the interaction pattern level classifying principle. To do so, we design the questions in the questionnaire based on a Likert scale with three levels, including low, medium and high.

When there are two to three questions for a construct, the method for using the questions to evaluate the performance of each construct is as follows: if any of the questions of the construct are reported as "low", the construct performance will be regarded as low. Table 4 then provides some exemplified evaluations of construct questions.

In sum, Fig. 7 depicts the entire process during the data collection module which gathers the information required for recognizing the pattern of the business interactions to be described in next module.

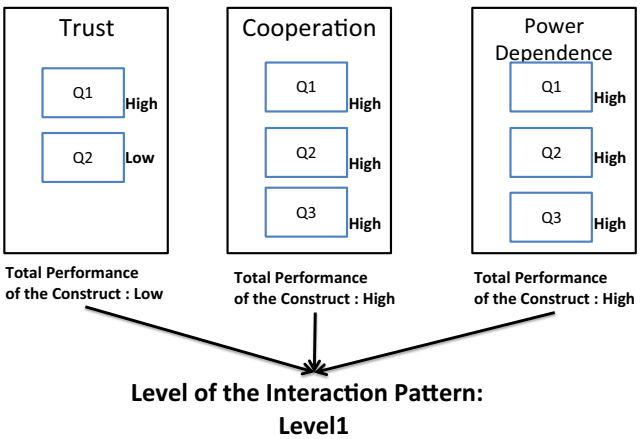


Fig. 6 Evaluation processes of the interaction patterns (Construct Performance: Trust: low; Cooperation: high; Power Dependence: high)

4.2 Interaction pattern recognizing module

Interaction pattern recognizing is an important part of the system, and the intent of the module is to analyze the interaction patterns the enterprise users are having with each entity and calculate the benefit that they would bring to the enterprise users.

The success of an alliance relies on the trust between two partners, the power dependence of their relationship, and the ability for cooperation on both sides (Whipple and Frankel 2000). These factors are very similar to the aforementioned constructs of the interaction pattern. This study accordingly extends the concept that a high level interaction pattern with an entity indicates that trust and cooperation between the two entities is high, and the power-dependency of the enterprise users towards the entity is low. The alliance performance will rise in accordance with the high interaction pattern level it is having.

However, the value of the alliance or the value of the interaction pattern is yet to be defined. This value should serve as the measurement of the service system design direction. For example, the meaning of a high interaction pattern is that it results in better alliance performance (Gravier et al. 2008). Since there are many types of benefits that can be achieved by an alliance, like access to the more resources, lower communication costs, better R&D ability (Alvarez and Barney 2001), we must choose a value definition that is most appropriate to make the enterprise users understand what kind of service system design directions the interaction patterns can bring, and the degree of the benefit the innovation can generate. Without a value definition of the interaction patterns, we will not be able to generate service system design directions for enterprise users to follow, and it might be hard to make enterprise users understand the advantages of the innovations will bring by adjusting interaction patterns.

Due to the requirements of the value definition attempted, this study adopts the different types of possible service innovation addressed by Johnson et al.(2000): major innovation, start-up business, new services for the market presently served, service line extension, service improvements, style changes. A higher level of service system design might not guarantee a higher value for an enterprise, but the possible and maximum value which could be created by a higher level are greater than those of low level service system design types. Explanations of each type can be found in Fig. 8.

There are three reasons behind this choice for service system values. Firstly, by using the different types of service innovation, we can link interaction with service system design to possible design outcomes more directly. Secondly, these types of service innovation could represent a sequential list of different difficulties and possible values brought by service system design. The bottom level of service improvements and style changing represents the easiest type of

Table 3 Influence of poorly performing constructs on interaction patterns

Interaction pattern condition	Results and explanation
Good in power-dependency Good in cooperation Bad in trust	While the two entities are bad in trust, it means that the two entities are not going to put themselves in the alliance. However, to create value from the alliance, it requires both of the entities have commitment to the alliance.
Good in power-dependency Good in trust Bad in cooperation	Cooperation means the two entities have the ability to work together and the two entities competence are compatible to co-create values that are needed. If two entities are low in the cooperation construct, it might mean the two entities can't create bigger value with alliance.
Good in cooperation Good in trust Bad in power-dependency	Power dependency can relate to how much the partner entity can influence the other. If the partner have higher influence on the enterprise user, it might suggest that any value that is created from the alliance might not going to benefit the enterprise user, so it won't be a good situation for the enterprise users.

service innovation, but also provides the minimum value of innovation for an enterprise; on the other hand, the top level of major innovation could leap from the current market and provide great value to the innovator by creating a new market, but it also requires the most resources and efforts and the highest risk.

Through this value definition, enterprises could capture the whole idea of how the interaction pattern might help them, and the connections between different value levels; in addition, by having a ranking mechanism, enterprises could understand their current status more easily for any future improvements. The third reason is that these different types of service innovation are highly compatible with each kind of interaction pattern. When enterprises lack resources and knowledge (e.g., SMEs), it will be difficult for them to carry out service system design by themselves. Accordingly, they will have a higher inclination to do basic service innovations, which are style changing and service improvements. However, while they are able to form a higher interaction pattern with other entities, more innovation insights and required resources will be given to the enterprise, granting them a higher possibility of doing high level service innovation. Table 5 shows a heuristic mapping list among the values types and the interaction patterns, followed by their rationales.

4.2.1 Level I - Service improvements, style changes

This is the default level for companies without the help and support of others. The target enterprise users of this system could have some minor insights about service system design based customer's vague opinions, but they lack the ability to do them well. In other words, they need the help of other entities to work on better service innovation.

4.2.2 Level II: Service line extension

When an enterprise with an entity in any type has a level 2 interaction pattern, the enterprise has a greater possibility of using service system design to extend its current service line. The followings then provide the rationales and examples behind different entity types.

- Lateral: Enterprises could integrate the ability of a lateral entity to extend their number of services, or lower the cost of their service to create a lower-price service for their customer (Todeva and Knoke 2005). Enterprises can also find new insights from enterprises in other industries. For example, a bakery goes to other bakeries to see their

Table 4 List of the influence of poor performing questions on the constructs

Questions of constructs	The impact of the questions to the constructs if the questions response is low.
The level of process-cooperation of the entity	Low cooperating ability results in low chance and needs to cooperate.
The level of the entity can respond to the requirement or solve the complaints	Results in the possibility that the partner entity might not be able to meet all the requirements of the enterprise users, which makes the cooperation performance low.
The level of cooperation of the actor during conflict	Low performing of this questions means the cooperation might not be long-lived
The level of credibility trust	Low credibility trust means the entity might fail the expectations and it will lower the trust
The level of benevolent trust	Low benevolent trust means the entity might take advantage on the enterprise later, resulting in low trust
The level of importance of this entity	If the entity is too important for the enterprise users, then the power dependency must be low since it's too important to lose.
The level of involvement of this entity in enterprise's process	For the degree of the entity involvement in enterprise's process, the higher means the entity is more important and heightens the power dependency
The level of irreplaceability of the entity	Even though the entity might not play important part in enterprise's process and have little influence to the market, if it is irreplaceable for the enterprise users, the power-dependency will be high.

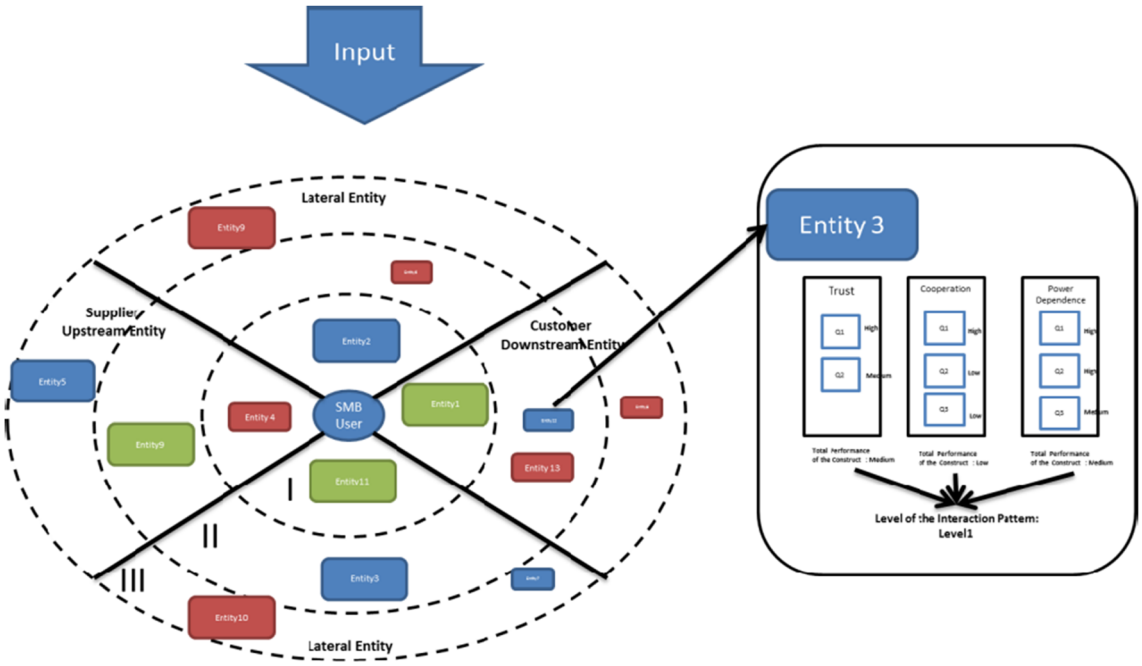


Fig. 7 The process of the data collection module

techniques or see how other kinds of SMEs do their job to attain some new ideas.

- Supplier: A supplier entity will enable enterprises to acquire more resources for enhancing the service lines (Stuart 1993). Insights of innovation could be applied more efficiently or with lower risk, thus when an idea for a new service under current service line or style is created, they will have higher ability to implement it for their customers.
- Customer: Linking with the customer could make their demands clear, which could possibly lead to more ideas about how to serve the customers well; also, it makes it so the new service could be communicated to the customers better (Bhattacharya and Bolton 2000)

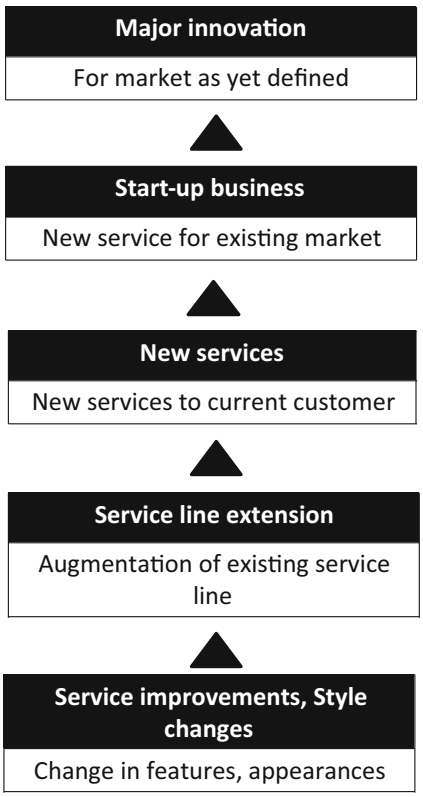


Fig. 8 The types of service innovation

4.2.3 Level III: New services for the market presently served

The synergy of bridging two different types of entities will create more possibilities for enterprises (Wandersman et al. 1997; Zuckerman et al. 1995), and increase the innovation type by extending current service to a higher level to create new services that the enterprise has not had before. However, the difference between major innovation and this level is that the service created in this level could be more easily copied by other enterprises, because a level 2 interaction pattern is not very difficult to form; also, the resources obtained from other entities could be less than at higher interaction pattern levels, making the innovation less influential.

- Lateral-Customer: By understanding customers better, enterprises can arrive at new insights that they had not thought of before and linkage with a lateral entity could help facilitate new insights. For example, a new food delivery service's needs could be discovered by customers, and a delivery company could help the enterprise to

Table 5 Interaction patterns mapping with service innovation types

Possible service system design level	Corresponding interaction patterns
Level I : Service improvements, Style changes	All interaction patterns being at Lv1
Level II: Service line extension	One of the interaction patterns being at Lv2
Level III: New services for the market presently served	Interaction pattern with at least two different types of entities reaching Lv2.
Level IV: Start-up business	Based on Lv3, having one entity with interaction pattern Lv3.
Level V: Major innovation	Interaction pattern with at least two different types of entities reaching Lv3.

dispatch their foods to customers efficiently, and without the risk of implementing it by itself. Another possibility is that a lateral entity could ignite enterprises ideas for new services, and then extend them to the SME's customers efficiently through good interaction patterns.

- Lateral-Supplier: In serving current customers better by providing new services based on cooperation with lateral and supplier entities, a lateral entity could provide new insights, and the supplier entity could facilitate the insight. On the other hand, some new resources that the supplier entity could provide for a new service might need the help of a lateral entity to make them become possible. For example, a hotel could make their own tour package for their customers by providing transportation service (lateral) and form an alliance with some tourism attractions (supplier).
- Customer-Supplier: New services can be provided to current customers if the enterprise discovers some possible needs during their interaction and implements them with the help of supplier entities. For example, a bakery could start a bakery-experience for its current customers (customer) by introducing them to their current bread factory (supplier). This could also be considered in another case where the bread factory (supplier) thinks of the bakery-experience idea. In this case, the bakery (SME) could help promote it to the customers (customer).

4.2.4 Level IV: start-up business

Through having higher interaction with an entity, the company is given a better chance to improve innovative service by knowing more about its customers, getting stronger resource from suppliers, and gaining wider distribution ability derived from lateral entities. This results in a higher possibility to create totally new target segments or types of service based on the foundation of having two entities with interaction pattern level 2 (having the ability to do some bigger innovation). Take the tour package example used in service system design level 3: by having a higher interaction pattern with the tourism attraction (supplier), the enterprise could design a very distinctive journey with the supplier entity. The newly-designed package could create a new service for the local area, and provide good access for customers to come to by the help of good transportation (lateral). For example, a hotel (SME) located in a remote area where there are hot springs, could make special a package for its customers by combining a hot spring (supplier) with paid home pick-up service (lateral), where the hot spring is free (provided by the enterprise and the supplier's good interaction pattern).

However, the service at this level might not be very influential because it does not have strong production or marketing ability overall, due to the lack of a sufficient number of allies. Like in the previous example, the tour could be extremely popular if the pick-up service is free of charge.

4.2.5 Level V: Major innovation

Similar to level III's condition, but due to the higher interaction patterns, companies have great chances to create very innovative and distinctive services, which it will be hard for competitors to duplicate, since the company already has build up a high level of horizontal or vertical interaction with its ally, and can link the forces together to create stronger value.

- Lateral-Customer: A new type of service could be achieved by receiving valuable advice and support from a customer entity, executing the idea with the help of a lateral entity, and receiving marketing. For example, a restaurant (SME) at a tourism attraction could provide delivery service of its famous dishes to hotels and hostels in the area with the help of a good delivery company (lateral), and support with the ads and promotions from good hotels (customer). By doing so, it could possibly reshape the food service industry in its area.
- Lateral-Supplier: Alliance with a strong competitor (lateral) and sources (supplier) could possibly provide an enterprise with strong bargaining power for better and cheaper materials that could make the enterprise very competitive, and cause great impact on the industry. For example, if the two greatest surfing equipment providers at an ocean scenery area join forces and ask manufacturers for a better price, they could possibly eliminate all other competitors within the region, and create a totally new image of the area.

- Customer-Supplier: Linking a strong service provider (supplier) with a good advertiser's (customer) marketing ability together could give a region have a different image. For example, a new tourism attraction could be created by a chocolate shop in an area where chocolate was never a famous product in the past. Enterprises without the necessary skills could potentially link with a good material provider (supplier) and promote products strongly by the help of advertisers (customer) to achieve the same effect.

Concluding this subsection, we define values of interaction patterns because providing a more concrete idea about how the interaction patterns could work for enterprise users, which will enable them to capture the idea of how interaction patterns work for them. In this study, the value refers to the types of service innovations. This value definition would make the linkage of interaction patterns with service system design more directly, because of the ordinal and sequential nature of the different types of service innovation, and the high compatibility of service system design types and interaction patterns. Through different interaction pattern combinations, enterprise users can then gain the ability to create different levels of service innovation.

Moreover, the mapping of different interaction pattern combinations with several service system design values increases the scope of the interaction results from a one-to-one relation to a one-to-more relation. We expand the interaction pattern from customer-supplier or supplier-customer into a broader view which includes customer, lateral entity and supplier entity. By adding a horizontal entity (lateral), the vertical-only interaction patterns are expanded into both vertical and horizontal enabled interaction patterns.

With the Interaction Pattern Recognizing Module and the Data Collection Module, we can gather and analyze the enterprise user's data to understand their current situation and the environment they are facing; also, we can analyze the business situation and fit it into the interaction patterns we have defined. With the understanding of the enterprise user's context, it can then move on to focus on the direction of its desired service system design.

4.3 Interaction pattern adjusting module

The adjusting module is designed to work with enterprise users and generate a possible direction for improvement of interaction patterns and service innovations. In Section 3.3.3, we have described how value can be created or achieved by some specific interaction pattern combinations. In order to create an adjustment direction for enterprise users to achieve these values, two different approaches can be taken: top-down or bottom-up. The top-down way refers to a value based adjustment, and the bottom-up way corresponds to pattern based adjustment.

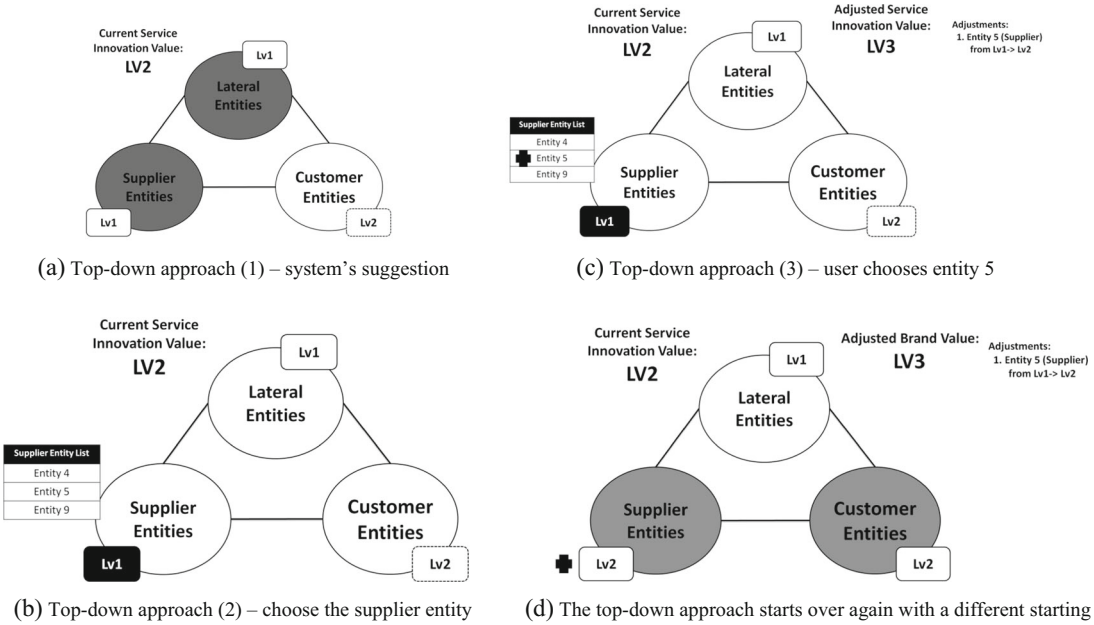
The top-down way of value based adjustment lets the enterprise user choose a value from the five levels of value. Our system can calculate a route from the current interaction pattern situation to the desired value's required interaction patterns (i.e., the possible directions toward improved service innovation).

The calculation of the route is based on a simple heuristic of finding the shortest route from the current interaction situation to service system design Level 5 according to the following assumption - most enterprises try to achieve the highest level of service system design. For example, if the enterprise user currently has interaction pattern Level 2 with a customer entity, according to Table 5′s matching rules in finding the closet route to service system design Level 5, it is to have a higher interaction pattern level with a supplier or lateral entity, and thus the system will provide two choices (supplier or lateral). After the enterprise user chooses an entity, the process will start over again, but from a different starting point (i.e., interaction pattern level being updated to Level 3), and make the enterprise user take the next choice of entities to achieve service system design Level 4. Also, if the value the enterprise hopes to achieve is not the Level 5 value, but a lower level of value, the calculation will still come up with an adjustment route for the enterprise user based on the aforementioned heuristic.

Figure 9a–d illustrates an example. Figure 9a shows the setting of the default value based on the data retrieved from the data collection module. Figure 9b shows the situation where an enterprise user has selected a type of entity it wants to improve. In Fig. 9c, we show the process of the user choosing an entity as its current target for level improvement (say entity 5), and increases the service system design level based on our defined rules. After the steps in Figure (a-c) finish, the system will reset the interface to be like Fig. 9a, but list the improvements the user has made based on their chosen entities on the right upper corner, and mark up the type of the entity by adding an "+" sign on its left as shown in Fig. 9d.

The second bottom-up way then adjusts the interaction patterns of the enterprise throughout the adjusting process. The possible achievable value will be calculated at the same time so that the enterprise users might try out many kinds of combinations of interaction patterns with different roles of entities and choose the combination of interaction patterns that seems achievable in light of its current status and the attractiveness of value it brings.

The bottom-up way provides more flexibility to the user, but it requires the enterprise user to expend more efforts. Figure 10a–b presents the idea of the bottom-up way: an enterprise user currently has the Level 2 interaction pattern with customers, and Level 1 with other entities. The system lists all entities sorted by their roles and asks the enterprise user to choose (Fig. 10a). Then the system displays the outcome after the enterprise user makes the decision (Fig. 10b).



(a) Top-down approach (1) – system's suggestion

(c) Top-down approach (3) – user chooses entity 5

(b) Top-down approach (2) – choose the supplier entity

(d) The top-down approach starts over again with a different starting point

Fig. 9 Examples demonstrating the ideas behind the top-down approach of Interaction Pattern Adjusting Module. (**a**). Top-down approach (*1*)—system's suggestion. (The system suggests that the user chooses types of entities to improve from two options, lateral and supplier, because it is the fastest way defined by our rules to achieve service system design Lv3) (**b**). Top-down approach (*2*)—choose the supplier entity. (The *black background box with the degree number* represents that the enterprise user chooses the supplier entity. The system will then list all entities that belong to the supplier entity type, which are entity 4, 5, 9 in this case, and ask the enterprise user to choose one of them as the next step to reach the improvement target) (**c**). Top-down approach (*3*)—user chooses entity 5 (The choice will be marked on its left, and the level-to-be after choosing an entity is displayed in the upper- right corner as a quick reminder) (**d**). The top-down approach starts over again with a different starting point (The system will ask the enterprise user to choose an entity type again, like in the step in (**a**), but there is a mark on the type of entity they chose before and there is a reminder on the upper-right corner; in this case, the system suggests the supplier and customer entities as the next improvement target)

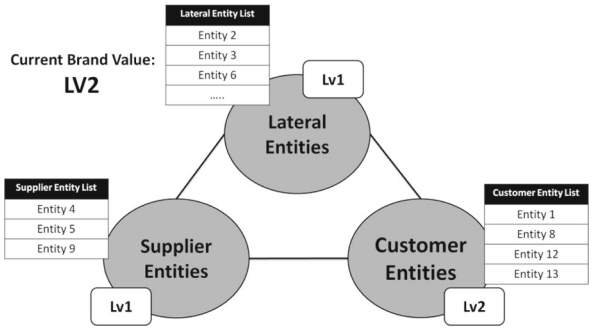
After the enterprise user attains with a value and the interaction pattern improvement direction within the module, these outcomes will serve as the first outcome the information system can provide, which is the direction of service innovation. It also provides insights about how glean innovation insights based on interaction patterns. By knowing which value to work on and the path to achieve it, the enterprise user can attain the right service system design direction. The next thing the system can provide is guidance throughout the process.

4.4 Alliance adjustment guiding module

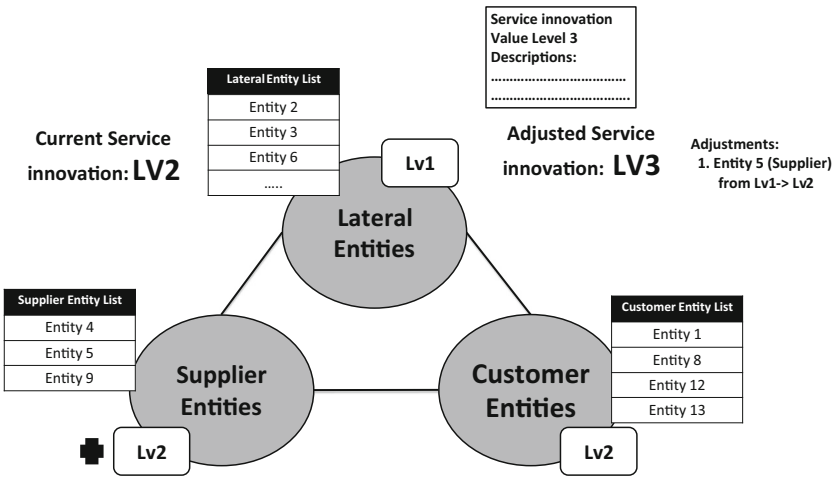
The purpose of this module is to link the service system design direction created from previous modules to a business case database that stores cases of related situations and selects proper cases for enterprise users to guide them through implementation. Using case base information is considered as a good approach for people to learn how to do things at the early stage (Anderson 1996), and it is easier to acquire examples of a problem solutions than to come up with rules to solve problems (Tenback 1994). The case database contains cases of enterprise achieving service system design in terms of improving interaction patterns. Each case is of an enterprise case and the results of service innovation. The solution for achieving the result must contain the adjustment of interaction patterns, and the case must describe the details of the solution.

After a case is selected, it will be categorized for the selection mechanism in the guidance module. The classification is based on the interaction pattern to which it is changing, the role of the entity with which it is changing the interaction pattern and the interaction pattern value which it will change. Figure 11 is the tagged information of a case example about an anonymous company's interaction pattern adjustment and the corresponding interaction pattern value changes; it is a case of an anonymous company changing its interaction condition with its customer and supplier.

At the beginning, we examine cases from other available studies, and determine whether the cases fit the following two requirements: the case company achieves some kind of service system design value improvement from changing interaction with other companies, and enough details are provided about how the company changed the interaction. If a case meets these requirements, then we analyze it to determine what interaction pattern it is changing and with whom it is changing the interaction pattern. After the analysis, the case will be recorded in the case data base and tagged with classifying information like that shown in Fig. 11. The case example in Fig. 12 is an example of classifying the information of a case about an anonymous company changing its service



(a) Bottom-up way – ask user to choose one type of entity



(b) Bottom-up way (2) – after choosing entity 5

Fig. 10 Examples demonstrating the ideas behind the bottom-up way of Interaction Pattern Adjusting Module (**a**). Bottom-up way—ask user to choose one type of entity (The system asks the user to choose an entity from among lateral, supplier, and customer entities) (**b**). Bottom-up way (2)—after choosing entity 5. (The change of the value of the entity is displayed in the upper-right corner. A mark is also given to show the entity type the user has improved within the system. The process goes back to the step as in (**a**) which is choosing a type of entity to improve)

system design value from Level 1 to Level 3 through changing its interaction pattern with its customer and supplier entity.

When the result of the adjusting module is brought into the guidance module, the result will be examined by the guidance module, in order to select the proper cases. For example, if an enterprise user wishes to change its service system design level from Level 2 to Level 5 by improving its interaction pattern with a supplier entity from interaction pattern Level 2 to Level 3, and the customer entity's interaction pattern from Level 1 to Level 3, the system will browse every case's tags to select the case that matches the requirements.

Figure 12 accordingly also exemplifies the case selection guiding process. The system records the steps the user selected during the process in the Interaction Pattern Adjustment Module, and selects the appropriate cases in this module. After the matched cases are obtained from the data base, the Guidance Module will then sort the cases according to the steps and the corresponding interaction pattern the enterprise chose to improve. In this example, two cases match the description of changing the interaction pattern level of the customer entity from Level 1 to Level 2, one case matches for changing the interaction pattern level with the supplier entity from Level 2 to Level 3, and two cases match for changing interaction pattern level with customer entity from Level 2 to Level 3. That is, the guidance module is designed to provide cases of businesses doing service system design by changing interaction patterns. After enterprise users choose their favorite case example based on their service system design direction, enterprise users are supposed to be able to reference the company in the case example when carrying out service system design by changing the interaction pattern with other entities within the enterprise user's current service system.

To conclude this section, in this study we present a novel interaction-centric service system design method and provide guidance-of-implementation for enterprises. We also implement a prototype system to demonstrate its attempted contributions. Section 5 will then evaluate our proposed approach in order to show it can help enterprise users carry out service system design by analyzing and managing interaction patterns with a more scientific research method.

Case : Anonymous Company
Value changed => No value(Lv1) -> Positioning (Lv3)
Entity interaction pattern changed :
Customer => Lv1->Lv2
Supplier =>Lv1->Lv2

Fig. 11 An example of the tagged information from an anonymous company's innovation case classification

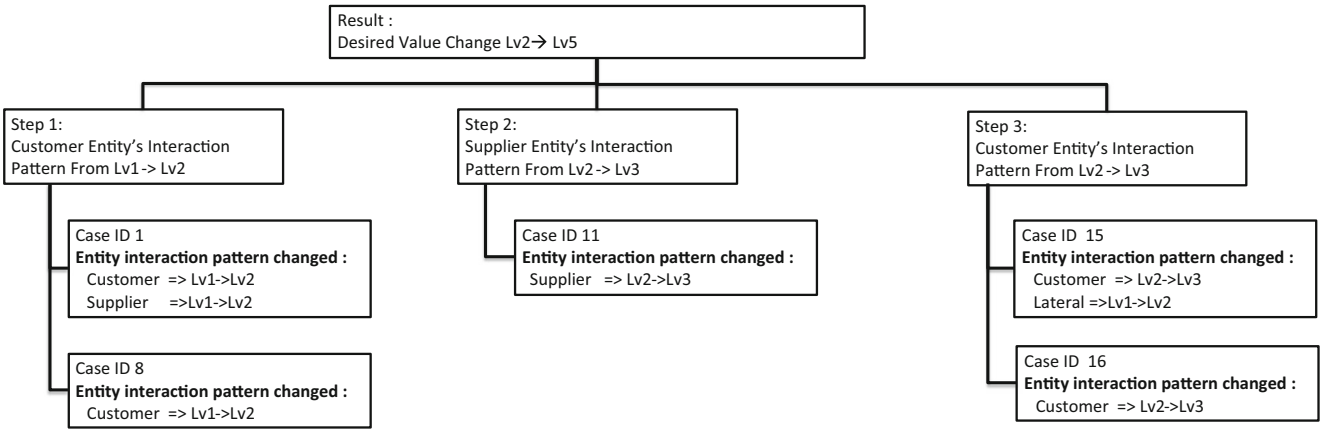


Fig. 12 Example of case classifying based on the patterns selected for improvement, and automatic proper case selection (Lv2→Lv5; customer→supplier→customer)

5 Propositions and evaluations

Evaluating design science artifacts takes on a variety of evaluation methods (Peffers et al. 2012), such as technical experiment (using real-world data or synthetic data to evaluate the technical performance), prototype (implementation of an artifact to demonstrate the utility), illustrative scenario (application of an artifact to a synthetic or real-world situation to illustrate its utility), etc. This study implements the prototype system and adopts the evaluation methods of technical experiment and illustrative scenario, simulating with synthetic data in order to demonstrate the prototype system's performance and utility.

The simulation technique often serves as an excellent analyzing tool for problems that are impossible or extremely expensive to observe in the ever-changing real world, but are possible to analyze if a proper and able-to-validate model is formulated (Maria 1997). Although we are not able to test our prototype system in the field for enterprise users, in this study we use the enterprise users of the Pillow Mountain Leisure Agriculture Area in Nantou of Taiwan as our illustrative scenario situation to understand the entities and their interactions in the real world in order to synthesize the simulation data. Based on our interviews and observations, we understand each enterprise entity (SME) at Pillow Mountain Leisure Agriculture Area's service system to be lacking in resources, loosely related (i.e., there are some conflicts between new comers and local enterprises, and the massive area makes it harder to interact frequently) and less familiar with business management knowledge (e.g., SMEs know less about how to exploit the benefits of alliances and interactions with other enterprises). This illustrative scenario is believed to be a good starting point to examine their aspiration to improve and innovate themselves in light of their inadequacy in resources and competence.

In the following subsections, Section 4.1 will provide the propositions of the attempted utility of our prototype system; Section 4.2 &4.3 will provide the details and results of different sets of technical experiments designed to examine the propositions.

5.1 The propositions

The fundamental idea of this study is to use interaction to support service system design. Accordingly, the first proposition of this study is to justify the effectiveness of an enterprise carrying out service system design by focusing on interaction; and only if this proposition is supported will the other propositions in this study stand up to scrutiny. In other words, this proposition serves as the premise of other propositions.

> **Proposition 1**: Interaction serves as an important aspect of business service innovation.

When the first proposition is supported, we can then verify the usefulness of our proposed interaction pattern adjusting model, which enterprises could use as a way to analyze their interaction situation. They could go on to follow the instructions given by the model to improve their service value and service system design. Hence, the second proposition is as follows:

> **Proposition 2**: While an enterprise follows the interaction pattern adjusting suggestions, they should be able to attain higher levels of service system design and service value.

Proposition 2 mainly exhibits the attempted utility of the prototype system in assisting enterprise users to utilize our approach of interaction pattern adjustment toward improved service system design. However, we believe different situations enterprises will affect the effectiveness of our proposed approach, such as different compositions and structures of service systems; for example, when an enterprise in the same

service system is more tightly related or more loosely related, the proposed approach's utility will be different. Hence, we have the following refined propositions about this issue:

Proposition 2-A: For enterprises with scarcer resources, the effectiveness of our proposed model will be higher.

Proposition 2-B: For enterprises that are more loosely related, the effectiveness of our proposed model will be higher.

Proposition 2-C: For enterprises that have less knowledge of exploiting the benefits of interaction, the effectiveness of our proposed approach will be higher.

5.2 Experiment details for proposition 1

5.2.1 Experiment design

Proposition 1 states that, "Interaction serves as an important factor in business service innovation". To make the experiment result easier to understand and more convincing, we will use a proper comparison target which can benchmark with interaction to see the effectiveness and importance of interaction within businesses by comparing the comparison target with interaction. We choose the comparison target based on the resource based view of alliances proposed Das and Teng (2001). The resource aspect of alliances is a widely accepted theory, and its usefulness has already been proven. If we can benchmark our proposed model with the resource based view of alliance theory, the significance of the experiment will be sufficiently convincing. Also, the main concept of resource based theory—companies form alliances to attain the resource they require - is an easy-to-adopt theory because of its simplicity. Lastly, the resource based view of alliance shows the feature of Goods Dominant Logic by addressing that companies choose partners based on the resources they lacks or considered important. Our approach encourages companies to find good partner candidates by analyzing and manipulating interaction, which is more of a Service Dominant Logic concept. Accordingly, we use the resource based view of alliance to compare interactions in terms of business service system design and value creating.

After selecting a proper target for comparison, to model the differences between resource aspects and interaction aspects, a comparison basis which can show their differences must be developed. Considering the characteristics of these two aspects, we use the functions of alliance as our comparison basis, which refers to a list of alliance functions that might occur between two partners, as described in the studies by Varadarajan and Cunningham's (1995) and Todeva and Knoke (2005). Some examples of these functions include franchising, co-marketing, and joint innovation. We believe that enterprises with different points of views will select alliance partners based on different reasons. For resource based partners selecting companies that find partners based on perceived ability and resources which they do not have, we can assume they will choose the alliance function to find a partner based on the partner's ability and resources. However, for those enterprises who take the interaction point of view, because interaction is the key to their alliance, instead of choosing which function to execute based on partners ability and resources, these enterprises choose the functions to execute based on their interactions.

In the technical experiments for verifying the effectiveness of interaction within service system design and service value creation, resource based companies will choose alliance functions based on partners' perceived abilities and resources, while interaction based company will choose the alliance function based on their interaction condition. By using the alliance functions, we can easily model two different aspects within our experiments, and verify whether interaction plays an important role in service system design or not by comparing alliance performance. Meanwhile, simulation techniques are applied to observe the differences between resourced based aspects and interaction based aspects by simulating how companies apply different approaches. By doing so, we can examine the service outcomes and values they acquire with a proper and convincing simulation model design.

5.2.2 Experiment design parameters

To synthesize the simulation data, we will randomly generate 100 SME enterprises and 10,000 customers in a tourist attraction region (to simulate the illustrative scenario of the Pillow Mountain Leisure Agriculture Area). Without loss of generality, each of the enterprises is assumed to provide one type of service - "eat", "live" (accommodation), or "entertain" to customers; and each of the enterprises has their own marketing ability to link with its customers. Each type of service is further assumed to have three different styles, for example, styles 1, 2 and 3 for eating. The simulations also assume that each customer needs different styles of service, and will not go to enterprises that do not provide the exact services styles he/she wants. Given the assumption that each enterprise only provides one type of service, an alliance is required to attract customers. The outcome value of the service system design of the SME enterprise's alliance will be calculated by the number of customers the enterprise can acquire to serve. Figure 13 shows an example. Enterprise A acquires Customer A (match) through live 2 and entertain 1, and improves marketing ability from 1 to 4 through alliances with enterprise B and C; however, the alliances do not lead to the proper ability and marketing ability to acquire Customer B and C (not match); so enterprise A is able to acquire only Customer A.

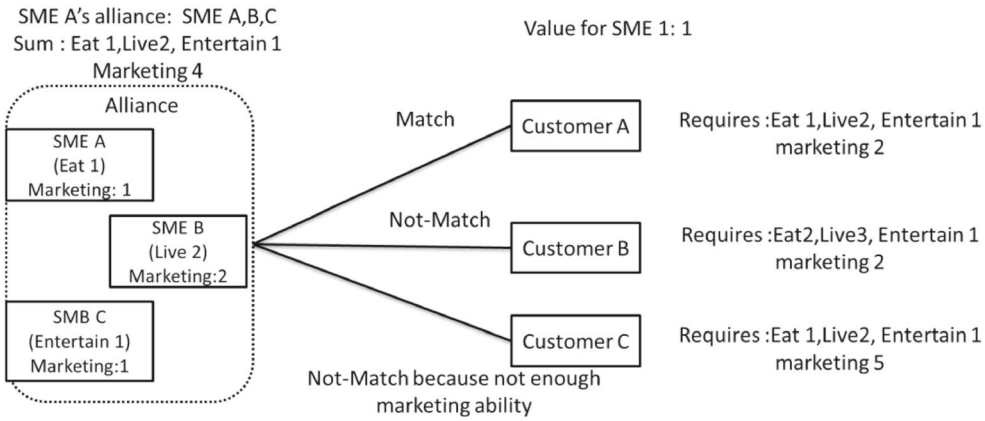


Fig. 13 Example of a SME enterprise's alliance and customer acquisition

Alliance success rate In order to make the illustrative scenario closer to the real world, we create a factor—alliance success rate, which represents the situation where alliancing or cooperating with other companies does not always bring benefit to business. The alliance success rate is considered as the possibility that enterprises could obtain positive value outcome from their alliance; for example, when the alliance success rate in the entire environment is low, enterprises will have low chances of gaining benefits from their alliance; contrarily, if the rate is high in the context, then enterprises will have a greater possibly of gaining more new ability through their alliance.

The alliance success rate can also serve as an indicator of whether enterprises in this region are good at building alliances. The reason for this is because one of this study's objectives is to provide good support for enterprises who do not know how to do service system design with alliances. To model this feature, we use low alliance success rate to represent these enterprises initially.

Also, we use this factor to demonstrate some differences between enterprises that take the resource based and interaction based views. In this study, we assume that enterprises focusing the resource based aspect will put their efforts into enhancing this factor because they choose partners with higher accuracy (e.g., choosing partners based on their perceived ability), and hence will put more emphasis on improving the effectiveness of this type of alliance—which will lead to a higher chance of building up a successful alliance; on the other hand, enterprises taking the interaction based view will focus on other things (as discussed below), which might lead to a lower chance of building a successful alliance. Through the alliance success rate, we can show different characteristics of enterprises ability in building alliances, and demonstrate these characteristics in our simulation process to see if any possible findings will occur.

Alliance functions and alliance constraints Although the alliance success rate can demonstrate some different features of the two aspects, it still does not mention how to present the alliance function in our simulation process, which is necessary within our experiments to prove the importance of interaction in service system design and service value creation within alliances. In order to model the resource and interaction aspects of alliance, we select 5 functions of alliance, according to Varadarajan and Cunningham's (1995) and Todeva and Knoke (2005), that are considered to fit into SMEs' situation and contribute to attaining the benefits toward service innovation. These functions include joint innovation, co-marketing, co-servicing, co-service & marketing and franchising. Each function leads to a different outcome. For example, joint innovation could possibly lead to a new service gain, and co-marketing could enhance enterprise's marketing ability.

In illustrative scenario, each alliance function has its alliance constraints, which are designed and based on each function's feature, and serve as a factor to model different context situations. Enterprises focusing on the resource based aspect, by definition, will choose an alliance function based on the perceived ability of their partners; hence, we model this feature through alliance function constraints. Enterprises taking the resource based view will have to follow their alliance constraints because of their alliance partner selection strategy and thus limit their possibility of trying other alliance possibilities. On the contrary, enterprises choosing the interaction aspect do not need to follow the alliance constraints because they do not decide the alliance function on the basis of perceived ability. Instead, they do so based on the interaction details. Through the alliance function constraints, we can separate the focus of the two different aspects and see their comparisons. Details of the alliance functions are listed in Table 6 (e.g., If two enterprises—enterprise A and enterprise B are both in the service type "eat", if they are following the resource aspect of alliance choosing strategy, the possible alliance function will exclude Co-Service & Marketing because

Table 6 Examples of alliance constraints

Alliance functions	Alliance constraints	Result
Joint innovation	No	Both enterprises acquire a new type of service or new style of service which they didn't have before
Co-marketing	No	Enterprises acquire partners marketing ability
Co-servicing	Happens within same service types enterprises	Enterprise A acquires enterprise B's service type and style. Enterprise B acquires enterprise A's service type and style.
Co-service & marketing	Happens within different service types enterprises	Enterprise A acquires enterprise B's service type and style. Enterprise B acquires enterprise A's marketing ability
Franchising	Happens within same service types of enterprises	Franchising enterprise acquires partner's marketing ability The franchising partner acquires the franchiser SME's service type and style.

the alliance is constrained. However, if they make their choice based on the interaction aspect, it is still possible for enterprise A and enterprise B to have the Co-Service & Marketing alliance function between them.

Following the above mentioned simulation design details, we can design different settings in each set of technical experiments to model the different service system contexts. In Table 7, setting 1 is the comparison basis—enterprises which do not make choices based on the resource based aspect or the interaction based aspect. Setting 2 stands for enterprises taking the resources based view which have higher alliance successful rates, in which we assume enterprise owners are focusing on selecting partners based on their perceived abilities (thus following alliance function constraints), and focusing on improving alliances to build stronger alliance outcomes (thus having a higher alliance success rate). Setting 3, the last setting, has the same success as in setting 1, in which the setting represents enterprises that achieve higher interaction tendency by not following the constraints of alliance (i.e., the situation where enterprises focus more on finding the most proper value proposition provided by partners, instead of their partner's core ability).

5.2.3 Experiment results

Figure 14a–c shows the results of the technical experiments. Figure 14a–b stands for the different ratios of new ability gained and marketing ability gained through alliancing by adding one more new partner in different settings. The ability and the marketing ability are acquired through alliances with other enterprises, and decided by the type of service the partner is servicing and the alliance function they are executing. The illustrative scenario simulates alliance building and ability gaining processes, accumulating the total ability gained and then calculating the ability gaining ratio.

Figure 14c shows the distribution of enterprises with different amounts of customers, like the number of enterprises who can acquire more than 1000 customers or those that can acquire 3000. The number of customers an enterprise can acquire is computed by the SME's ability and marketing ability, as well as customers' tastes. For example, if enterprise A acquires the abilities Eat 1, Live 2 and Entertain 1 through alliance, then the simulation program will count the number of customers whose requirements are just like those satisfied by enterprise A's service.

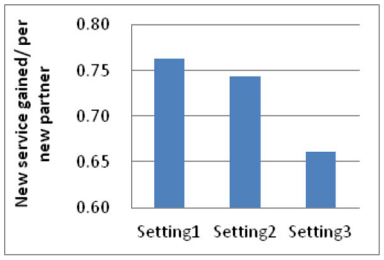
The results of settings 1~3 show that when enterprises focus more on the resource aspects, the ratio of their ability increased by per new partners is much higher than for enterprises that do not focus on resource based aspects. These two figures make it obvious that by concentrating on resource based aspects, enterprises have better efficiency and ability to gain from alliances.

However, from Fig. 14c, we can see that settings 2 and 3 show some characteristics which are different from those in Fig. 14a-b. In Fig. 14c, settings 1 and 2 indicate that a much higher number of entities is attaining inferior outcome value in terms of the number of customers obtained (the left hand part); however, setting 3 shows a much better outcome value in terms of acquiring more customers by having more entities in the right hand part in Fig. 14c than in settings 1 and 2.

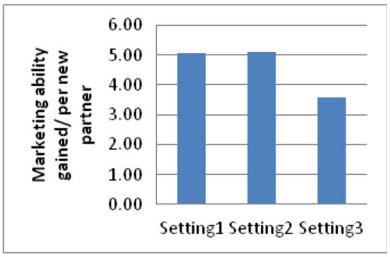
Combining the results of the three figures, while Fig. 14a–b indicates that the SME has better performance in gaining ability under a higher resource based tendency in an alliance situation, Fig. 14c shows that even though some enterprises gain more ability per new partner when focusing on resources; in

Table 7 Settings of different alliance contexts

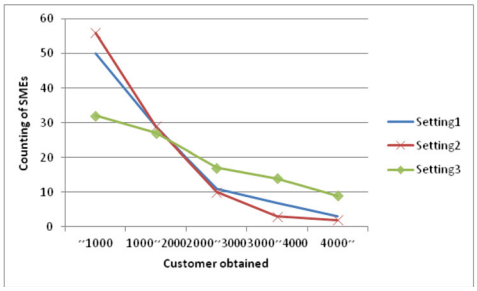
Settings	Successful rate	Alliance constraints	Represents
Setting 1	Low	Enterprise will follow the constraints	Comparison basis
Setting 2	High	Enterprise will follow the constraints	Enterprises of resource based aspect
Setting 3	Low	Enterprise will not follow the constraints	Enterprises of interaction based aspect



(a) New service obtained per new partner



(b) Marketing increased per new partner



(c) Actual market size distributions of all settings

Fig. 14 Results of proposition 1 testing

fact, they are not doing better than enterprises with higher interaction tendencies. A possible explanation for this contradiction is that even though enterprises heavily focusing on the resource based view are more efficient in finding partners to increase their abilities, they might fail to meet to their customers' expectations. However, enterprises with higher interaction tendencies can find partners that are able to provide critical components to their service value propositions for customers, hence, resulting in better consequences.

If we apply these explanations to our propositions, Fig. 14c shows that the comparison of setting 3 with settings 1 and 2 reveals that interaction-centric enterprises are doing much better in alliances for service system design than resource-centric enterprises. Accordingly, we can say that our first proposition that interaction serves an important role in service system design and service value creation is supported, because it has the same or even better performance by acquiring more customers than the well-recognized resourced base alliance selection approach in this simulation. Hence, we could argue that interaction is an important factor in enterprises' alliance building if they pursue better outcomes from alliances, and we are able to move on with our other experiments given that this premise has been justified.

5.3 Experiment details for proposition 2

5.3.1 Experiment challenges and design principles

After justifying the importance of interaction in Section 4.2 through the simulated scenario, we subsequently investigate the effectiveness of our proposed interaction pattern adjusting model in helping enterprises analyse and manage their interaction patterns to obtain higher valued service system design for alliance. In this set of simulation experiments, we examine the outcomes of enterprises who apply and who do not apply our model in different situations, and evaluate the usefulness of our model.

5.3.2 Experiment design details

In this set of technical experiments, two additional factors are considered for simulating the illustrative scenario: (1) the degree of interaction quality and (2) company resources.

Degree of interaction quality The degree of interaction quality refers to the intensity and quality of the interactions between enterprises within the region. With a higher degree of interaction quality, enterprises should have better and denser interaction with each other, and this should result in a higher possibility of gaining benefits or service system design insights from others. During the simulation, we model this through assuming enterprises with a higher degree of interaction quality will have a higher alliance success rate, and thus have a higher chance to benefit from the alliance.

There are two considerations for adding the degree of interaction quality as a factor. The first is that the experiment targets we have chosen is Pillow Mountain Leisure Agriculture Area, in which the enterprises are considered as having more loose inter-business relationships due to their far

distance from each other, and it is also harder for the enterprises to form high quality and intensive interactions. Hence, we apply the degree of interaction quality to model this phenomenon, and see the differences which might occur within different given values of the degree of interaction quality.

The second reason for considering the degree of interaction quality as a factor is that it can serve as an experimental method to measure interaction pattern levels, in which a higher degree of interaction quality can imply a higher interaction pattern level, which can subsequently be used to help verify our proposed approach. In the simulations, a degree of high interaction quality will be considered as representing a level 3 interaction pattern with another enterprise, a normal degree of interaction quality will refer to a level 2 interaction pattern with another enterprise, and a level 1 interaction pattern will be modelled by having an inferior degree of interaction quality with another enterprise.

For different configurations of the experiments, the rate at which a higher degree interaction quality occurs will be adopted. Enterprises under a higher high-interaction-quality degree setting will have a higher possibility of having a higher degree of interaction quality with other enterprises, which simulates areas where enterprises are very cooperative and more tightly bonded. On the other hand, if the given situation is that enterprises have a low high-interaction-quality-degree, then enterprises under this setting will tend to have a lower degree of interaction quality among them, which simulates areas where enterprises are highly competitive, consider other enterprises as opponents, and seldom interact with each other. For example, if the degree of interaction quality is high, two SMEs, enterprises A and B, will have a very high chance of having a higher degree of interaction quality; if the rate is low, then enterprises A and B will possibly have poor interaction quality. However, enterprises A and B can still improve their degree of interaction quality by using their company resources, which will be explained in the next section.

Company resource This factor represents the resources enterprises hold to improve their degree of interaction quality with other enterprises; when enterprise A wishes to enhance its interaction quality with enterprise B, it will take both enterprise A and enterprise B's company resources to fulfil the enhancement. In addition, the costs of improving different degrees of interaction quality will be different. While enterprises can reach a level 2 degree of interaction quality with another enterprise with relatively little cost, it is assumed to be more difficult to improve this relationship to a level 3 degree of interaction quality.

The purpose of this factor is to serve as a limitation, and show the effectiveness of our model under this limitation. Our proposed interaction pattern adjusting model provides an analysis method and guidance for enterprises to decide their strategy for adjusting interaction patterns. While given limited company resources, enterprises cannot choose every other enterprise to improve interaction quality (interaction pattern), so the strategy for choosing the proper target will be important. We would like to see the different outcomes of customers obtained by enterprises when the enterprises follow and do not follow our model's suggestion.

Responding to propositions 2, 2.A, 2.B, and 2.C, we design 4 settings with different configurations of these 3 factors, as listed in Table 8. Setting 1 refers to Pillow Mountain Leisure Agriculture Area, in which the enterprises are loosely related, lesser in resources, and lower in knowledge and ability to form good alliances and benefit from them. Settings 2 refers to places where enterprises have business knowledge (knowing more about how to make good alliance), but have loosely related inter-business relationships and few resources. Setting 3 is for places where enterprises have abundant resources, but do not have good inter-enterprise relations and lack sufficient knowledge for entering into business alliances. Setting 4, the last setting, is for enterprises which have good interaction with others, but lack resources and proper business knowledge.

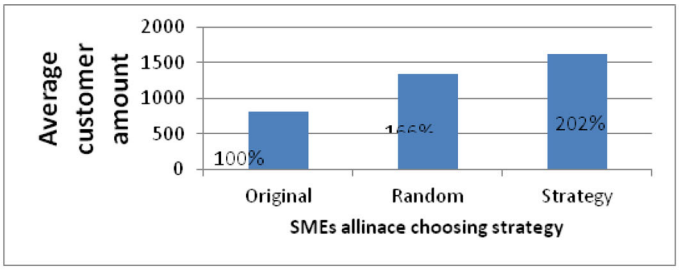
5.3.3 Experiment results

Figure 15a–d are the results of the technical experiments. These results verify the strategy behind our proposed approach under different settings, benchmarking with the random choosing approach. Figure 15e shows the comparison between them. As in the previous experiments, the way we define how well our approach works is by comparing the number of customers an enterprise can acquire after adopting our approach with those the enterprise can acquire without adopting the approach.

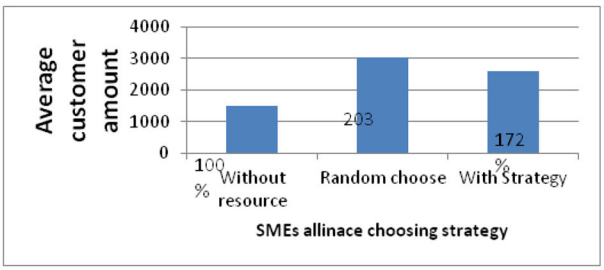
From Fig. 15a, for enterprises which apply our approach's suggested strategy, the total number of customers acquired grow 102 %, and for those which do not follow our approach (i.e., the random-choosing approach), the total number grows 66 %. Under setting 1, following our strategy is better for enterprises. However, from Fig. 15b–d we can see a totally different situation where enterprises which follow our strategy are not doing as well as those who do not. Figure 15e shows a very clear comparison showing that only under setting 1 can our approach do better; accordingly, we may only be able to apply our approach to the context of setting 1.

Table 8 Settings of different simulation factors

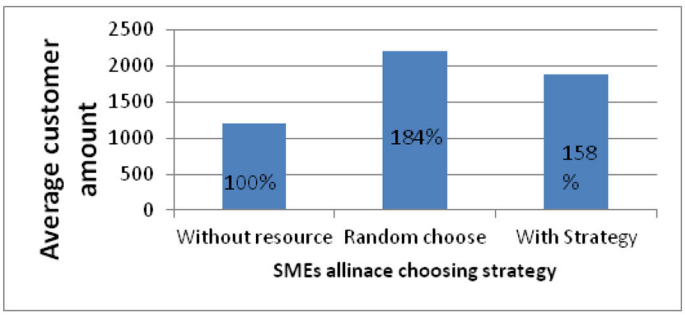
Settings	Interaction quality degree	Alliance successful rate	Company resource
Setting 1	Low	Low	Low
Setting 2	Low	High	Low
Setting 3	Low	Low	High
Setting 4	High	Low	Low



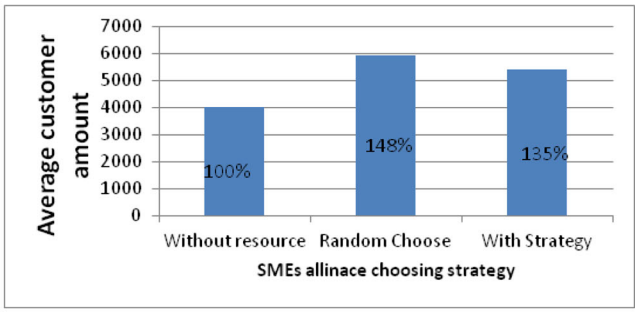
(a) Results of Setting 1



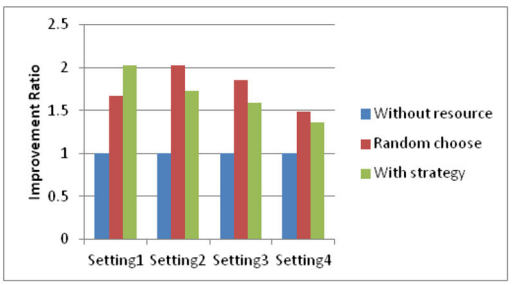
(b) Results of Setting 2



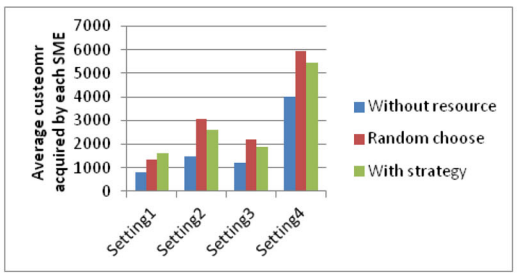
(c) Results of Setting 3



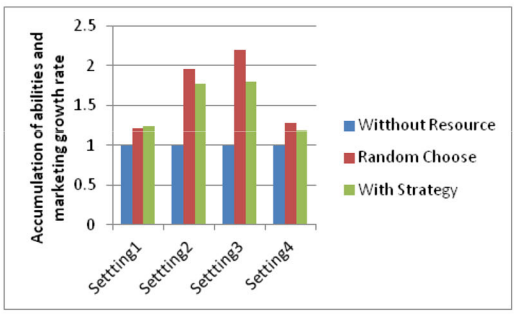
(d) Results of Setting 4



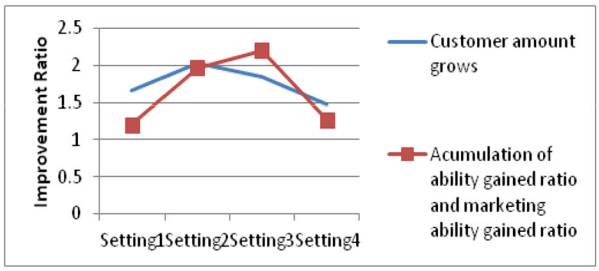
(e) Comparison of improvement ratio of average customer acquired under all settings



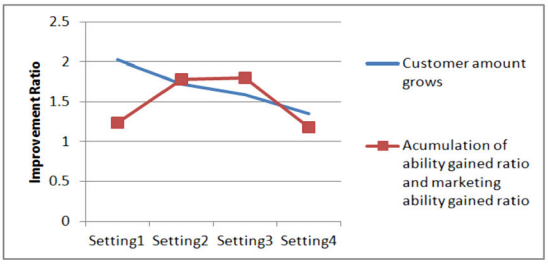
(f) Average number of customer acquired by enterprises under each setting



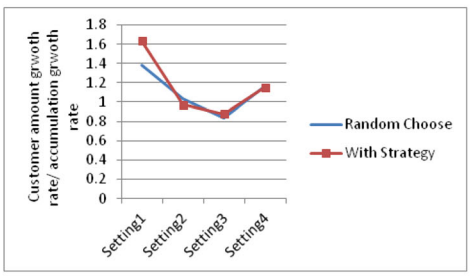
(g) Comparison of the accumulations of abilities and marketing under different settings



(h) Random Choosing



(i) With Strategy



(j) Comparison of relationship of improving accumulation growth rate (ability and marketing) and customer growth rate under randomly choosing and following strategy

Fig. 15 Results of proposition 2 testing

To discover the reason why our approach can only be applied to setting 1 (where enterprises with less resources, less businesses management knowledge and looser relationships), we gather other data from the simulation process to explore more details. Figure 15f represents the average number of customers each enterprise could acquire under each setting. We can see that enterprises under setting 1 have the lowest average, and setting 4 has the highest. Compared with the improvement ratio data shown in Fig. 15e, while the amount of average customers is higher in setting 4, the effectiveness of both strategies and random-choosing is getting lower; in contrast, when the average number of customers is lower, the effectiveness of building alliances becomes more important. This information reveals a situation where adjusting the interaction pattern will be useful (i.e., where the average performance of the region is lower), but does not explain why our strategy is not applicable under other contexts than that in setting 1. Consequently, we try to find the reasons from another perspective—the ability gaining perspective.

During the simulations, two factors affect how many customers enterprises acquire, as mentioned above—ability and marketing. The abilities determine the maximum number of customers an enterprise can obtain, and the marketing ability influences the percentage of customers the enterprise can acquire from its able-to-acquire customers. Hence, the amount of customers acquired should somehow be decided according to the growth rates of these two factors.

Figure 15g shows the comparison of the accumulation of abilities and marketing. From Fig. 15g, we can see that only in setting 1, for those enterprises who follow our approach, their accumulation of abilities and marketing growth rate is higher than those who do not follow the approach; in other words, only under setting 1 does the strategy proposed based on our approach benefit the enterprises, which is same as what we discovered in Fig. 15a–e.

However, although the comparison of results under each setting in Fig. 15g shows the same trend as that in Fig. 15e, there are still different findings to be found from Fig. 15g. If we cross analyze the improvement ratio of customer growth and the accumulation of ability and marketing growth rate as shown in Fig. 15h–i, we can see that under settings 1 and 4, the ratio of the accumulation of the growth rates of the two factors is lower than the customer growth rate; and in settings 2 and 3, the growth rate of the accumulation of the two factors is the same as or higher than the customer growth rate. Combining these findings with Fig. 15e, we can see that whenever the effectiveness of following our approach is higher or almost same as randomly choosing, the accumulation growth rate of ability and marketing is lower or almost the same as the customer growth rate. In other words, when the ratio of customer growth rate to the accumulation ability/marketing growth rate is higher, our strategy is more effective. Figure 15j shows the comparison.

This discovery reveals the situations when our proposed approach will be effective. First, when the effectiveness of gaining benefit from other enterprises through a high degree of interaction quality is lower, it means the difference between a high and low level of interaction degree is smaller. In this case, the effectiveness of our strategy is lower (i.e., setting 1 compared with setting 2). Secondly, when the cost of achieving a higher degree of interaction quality is relatively low (i.e., setting 1 compared with setting 3), the effectiveness of our strategy is also lower. Lastly, when the scarcity of a higher level of interaction quality is lower, or in other words, when it is relatively easy to have high interaction quality with other enterprises, our strategy will also be less effective (i.e., setting 1 compared with setting4). In contrast, when the effectiveness, cost and scarcity of interaction quality are all relatively high, enterprises should apply our approach and follow the suggestions it gives.

These findings are aligned with the aim of our proposed approach. In our approach, we already presume the scarcity of higher interaction quality (interaction pattern) is high by assuming that a level 3 interaction pattern can only be achieved when all questions within the questionnaire are responded to as “high”. Also, there are only few steps or improvements required for an enterprise to improve to a level 5 service system design value from level 1, which somehow implies that each step of improvement is highly difficult and costly, and is in accord with our findings. Lastly, interaction is a crucial element in business and is the fundamental concept of our approach.

In short, our approach can benefit enterprises when the effectiveness, cost and scarcity of interaction quality are high. The usability of our approach must be evaluated by comparing the customer growth rate and the accumulation of the growth rates of ability and marketing, if possible. When the customer growth rate is lower or equal to the accumulation of the growth rates of ability and marketing, it indicates that one of the factors that influence interaction quality, either effectiveness, cost or scarcity, is low. In such a case, the proposed approach will become inappropriate for enterprises to comply with. However, if the effectiveness, cost and scarcity of interaction quality are high, making the customer growth rate higher than the accumulation of the growth rates of ability and marketing, our proposed approach will be very useful to enterprises to improve their service system design value.

6 Discussion

Previous literature stated that interaction is the basis unit of business analysis (Håkansson 1982; Håkansson and Snehota 1995; Naude and Turnbell 1998) and service value creation (Aronson 1997). In this study, we push this concept one step further to that interaction could possibly become another focal

of alliance building and value creation that is worthy to be recognized by enterprise owners.

In the first set of technical experiments, it has been justified that when benchmarking with resource based of alliance building concept, the interaction centric perspective could outperformed resource based alliance building. Based on the findings learned from the experiments (e.g., increasing the value of alliance), enterprises shall enhance their linkage with other enterprises to improve their interaction density to discover more value possibilities within their current service system.

In the second set of technical experiments, the findings reveal the proper situations when our approach will possibly work. That is, enterprises who are located in highly competitive area, without enough resource, and lack of proper business managing knowledge to improve their service, can possibly gain more advantage by adopting our approach than any other kinds of enterprise users. Accordingly, an enterprise falling into this category is encouraged to adopt our approach by examining the other enterprises within their service system in terms of the roles of customer, lateral and supplier entity according to their interaction levels, and follow the suggestions to design their improvement route to achieve a higher service value.

The novel view of interaction we have presented offers substantive implications for business and strong standing position of system thinking. However, besides the grand notion of system thinking that entities interact to create outcome in an ecology, we borrow some key concepts from the current system thinking framework. Instead of embracing the whole traditional system thinking framework within our study, we also discover some other perspective of system thinking by focusing on a specific value type.

The system thinking model separates interactions into two categories—value proposition driven and governance driven. In this study, we map different possible values (i.e., service innovation value levels) to different combination of interaction patterns; also, we use acquirable customer number as the value measurement in our experiments. These are all focusing on how value is created from the interactions of system entities (i.e., value proposition driven interactions). However, it is yet to be analyzed how system thinking can further describe the structure of value proposition driven interactions.

The interactions toward service innovation could be perceived by two elements, current interaction pattern and value proposition. Interaction pattern describes how the interaction is preformed, and regulates its possible maximum benefit, such as our interaction pattern level three with two different types of entities could possibly lead to the level of major innovation in their system, and the four constructs (trust, power dependence, cooperation and expectation) and the entity types can be used to classify what the interaction level is.

The value proposition then expatiates the desired outcome of both sides through a process of value's proposal, agreement and realization. The proposal indicates the original value that each side desires, but after the negotiation process it will be altered and become the accepted agreement between entities. Realization then stands as the final value proposition of entities, but also might be altered when putting the value into a bigger ecology scope; also, the final value might feedback to the entity and the interaction patterns. In this study, our proposed approach and its information system are tackling the proposal part by providing a model for enterprises to imagine and consider what level of service innovation that they shall try, and the agreement part by providing them with cases to guide how they can achieve the desired value. In addition, combining our concepts of interaction patterns, value propositions and the process of proposal, agreement and realization, a model of value proposition driven interaction could then be established as depicted in Fig. 16.

Although system thinking can consider the outcomes in a wide variety of forms, this study perceives value in terms of service innovation levels. This could make the system thinking analysis become more adaptable to business analysis in terms of concentrating on the value creating process within interactions. This could empower enterprise users to understand more about how their interactions with the other entities influence their final outcome, and to manage their interaction pattern or value proposition.

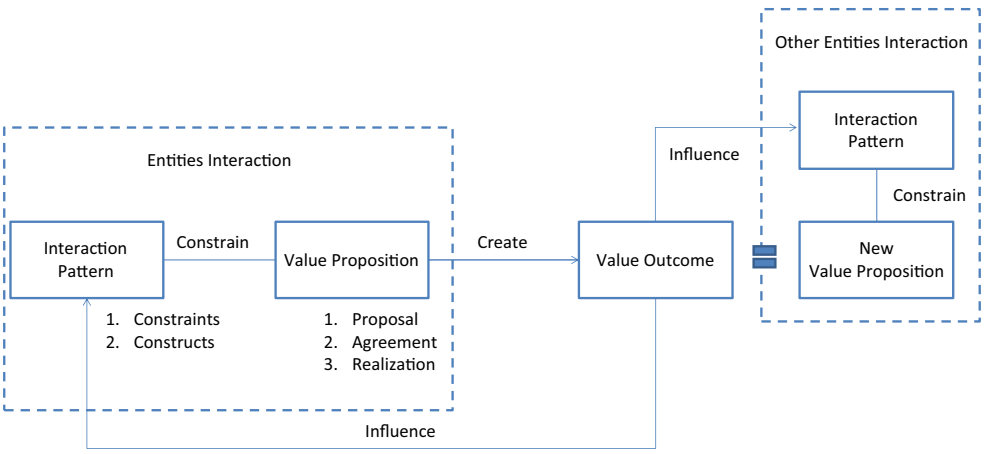


Fig. 16 Model of value proposition driven interaction

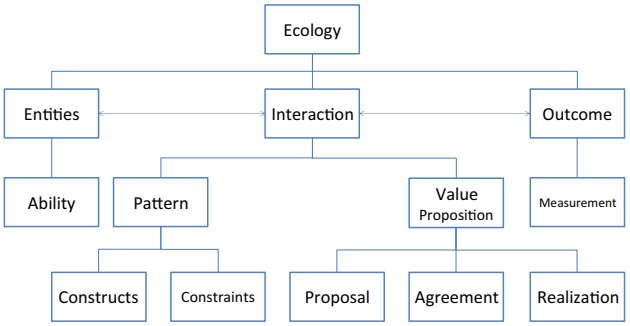


Fig. 17 Value oriented system thinking framework

However, when associating interaction patterns to areas other than service innovation levels, it is believed to be feasible by simply finding new mapping logic between value proposition and interaction patterns. This notion of changing interaction pattern and value proposition types would render interaction pattern and value proposition as the entity-like concept, which can be replaced by new entity for new purpose. Accordingly, we can adapt the system thinking framework to the one shown in Fig. 17, which implies a set of important issues required to explore for further developing the system thinking related theories toward service innovation.

7 Conclusion

This study is the first attempt at presenting an entity interaction pattern centric approach for service system design. This approach creates an evaluation method that could be used to analyze enterprise interaction patterns, to assess their current business performance and environment, and help enterprises improve the service outcome's values through changing their enterprise interaction patterns. In this approach, we divide all entities within a service system into three categories: customer, supplier and lateral entity; each entity provides different value proposition and could improve their possible value provision by changing the interaction pattern with the other entities, and the accumulation of all entities interaction patterns could be further calculated into the enterprise service value level. When a specific value type of the service system is given, the interaction pattern and value proposition could serve as an entity-like notion and become replaceable and changeable by different settings of pattern and value proposition for different analysis target. Our evaluation results also evidence interaction serving as the focal of service system design and the usability of interaction pattern toward service innovation. That is, the idea of analyzing and developing interaction pattern lead to the creation of our system prototype used for measuring interactions and assessing or manipulating interaction patterns toward improved service system design.

Although the notion that interaction has been regarded as the important role to derive business outcomes as addressed by system thinking researchers for years, it still remains as abstract concepts. This study provides some concrete evidences within the technical experiments by comparing our approach with the benchmark theory—resource based perspective of alliance building and choosing. Future researchers could apply our approach and model as their basis of interaction pattern research, and enterprise users could also apply our approach to improve their service system design.

However, this study has some limitations such as the separation of different interaction pattern levels needing further investigation in order to reduce possible classification ambiguity, real field tests to collect practical interaction data besides the technical experiments, expansion of illustrative scenario targets, etc. The future researchers can also further investigate different categories of system entities, different entity interaction patterns, different service value levels, different entity replacement mechanisms, etc.

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