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ABSTRACT

E-business development is a considerable complicated task because the underlying logics of e-business and its new processes that are originated from implementing enhanced information technologies to streamline business performance introduce many complex issues. One of the difficulties is to capture the dynamic aspects of e-business that can be used for monitoring the business performance, in a way that could be helpful for the business adaptation to meet competitive advantages. Among many dynamics of e-business, the value system is the most interested one that has recently been addressed. However a value system is at the strategic level with no formal approaches for its representation, which introduces a gap between system modelling and implementation in the e-business development. In this paper, we will investigate a so called value process that can be not only used for value system modeling, but executed for simulation of the resulted model. For the purpose of value process modelling, we will adopt the process algebra approach, which will be integrated with others such as workflow in our modelling environment.

Keywords: E-business, value system, value processes, e-business modelling.

1. INTORDUCTION

There are considerable difficulties in modelling e-business and its processes, because e-business dramatically changes traditional business value systems and the patterns of action and interaction that bring together processes from different companies, sites, suppliers, distributors, service providers etc, as well as the new processes emerging from business needs to support the collaboration, coordination and cooperation. The e-business era has introduced many new paradigms, that has given a rise to a need for appropriate tools and modelling mechanisms that support for the better understanding and the decision making of the business and its process development.

An e-business is considered here as the integration of business rules, a viable trading mechanism and associated processes into a business approach that leverages the network (Internet) as its medium of transaction, it is thus composed of the characteristics of the definition of the offered products and services, the targeted customers, identification of the involved business partners and their roles, and the value propositions among business actors. With this context of e-business, the business strategy analysis will be, not only in business itself but in business process as well, an important element in e-business development. The business strategy analysis is a methodology of configuring the business value system that consists the value architecture and the value dynamic at run time. For the given business strategic plans and goals, the processes of developing a sound value system and value process underlying the value system become vital for e-business to be successful.

Recently the value based approaches have been advocated in e-business modelling [1, 4, 6, 8, 17, 23]. In these modelling proposals, e-business modelling is about the value and value operation for what is offered by who to whom in term of value, while e-business process modelling is the concerns of how the value offerings are selected, negotiated, contracted and fulfilled operationally [3, 4, 7, 21]. In [5, 6], an e^3 value based approach has been proposed that rigorously describes value exchange among business actors and formalises a value exchanging architecture based on requirements engineering and case mapping techniques. Because of the "soft" and complex nature of e-business, the description of e-business modelling is remained at the conceptual level, some graphical tools have been developed for visualising the business actors, value flows and value relationship among the actors, which can help in e-business value system development [4, 5]. However, the lack of computation mechanisms in the conceptual model of the value system causes the difficulty for simulation and feasibility testing. In this paper, motivated by e-business modelling demands, we propose a novel value process modelling approach that brings the e-business modelling and its process modelling together in a single form. With the computable for simulation in our mind, we adopt the process algebra [2, 11] as our modelling language that addresses two fold in e-business modelling - static and dynamic characteristics of the e-business value system. The value process of e-business is nothing but the values and operators that model what and how the value is created and transmitted within e-business with respect to the strategic plans and goals.

This paper is to study the value process modelling, and examines how to facilitate the modelling results to

derive e-business processes. The remainder of this paper is organised as follows. Section 2 presents the background of e-business modelling by reviewing the requirements in e-business modelling demands, and addressing the important relationship between the value system and the e-business process. In section 3, the value process is discussed using the adopted process algebra. In section 4, we give an example to show how the value process can be used in e-business modelling and development. Finally in section 5, the conclusion is given, and our further considerations for the remaining issues are addressed.

2. BACKGROUND

In this section, we briefly review the related literature in e-business modelling from the value point of view, and examine the value system of e-business, which gives the background for our development of the value process.

2.1 Value Based e-Business Modelling

An economic activity is directly toward the creation of value. A business is considered superior comparing to others, if that business offers a superior value to its customers in the competitive marketplace, and gains benefits from it. A value is an economic concept, not primarily measured in physical performance attributes, rather what a buyer will pay for value object - product, service, information and knowledge. A description of these related strategic value plans is *Value Proposition*. The constituents of a value proposition may include the clear answers of questions such as

- What are the contents of value to be offered?
- Who are the end users of the value?
- Where are the end users?
- What are the benefits for the end users, partners and itself?
- Why ought the end users accept the value offered?
- What the benefits the business can gain by offering the value?

Value proposition can be understood as the statement of benefits that are delivered by the business to its external constituencies, and that are gained to the business itself. However, the statement of a value proposition is often an informal one that can only be understood by the experienced business modellers. It is difficult to be understood by those who carry the development of the e-business processes and softwares. It is preferable that a formal approach defines a value proposition. Inspired by the works of several researchers in business modelling [4, 10, 12, 21], the value proposition may be described by four attributes including customer needs, value creation, value level and value price level. These attributes are closely related to the value articulation. The customer needs include the concerns of usefulness, risks and effeteness of the value offered to the

customers. The value creation is the way of how the value can be created at the moment of the value life cycle of value object creation, consumption, renewal and transfer. The value level is the measurement of the value comparing to its competitors in scales of similarity, innovative imitation, excellence and innovation. And the value price level is the proposed price by comparing to one or all of the competition in the scale of free, economy, market and high-end. We note that defining a value proposition is the first step in e-business development, which requires business strategies that clearly point out the attributes of the value proposition. A value proposition, however, only provides a broad view about what the values of the business are to customers and itself. We can not see how the business operates the values at this level of modelling phase, which a value architecture is required that describes the partners' value relationship, capability, competence and resources for fulfilling the value propositions.

The value architecture addresses the problems such like who are involved and what the roles the actors play in the business, what relationships are among actors, and what activities and resources are needed to fulfill the promised benefits to the customer in an efficient way. The value architecture has been explored by several researchers, for example the e^3 provided a model of the value architecture that focuses on value and value exchange [5]. Generally speaking, the value architecture can be regarded as a value system that is a connected series of organisations, resources, and knowledge streams involved in the creation and delivery of value to the end customer. It is centralised about the value creation process and the problems of how to anticipate customers' and partners' processes by using Internet technology. Value systems integrate the business activities, from determination of customer needs through product/service development, production/ operations and distribution. For such integration, it is required that the processes underlying the value system have to be explored. We consider that the value system is the aggregation of value processes that need to be modeled for e-business development.

2.2 Value System and E-Business Processes

To approach each business opportunity, adaptive business processes are required for continuously restructuring value systems. The relationship between the value systems and e-business processes is that the former provides the guidelines for how the e-business process should be in order to offer better values to its customers, while the business processes support the value systems such that the valid processes are facilitated to fulfill specified requirements of the value systems. Figure 1 shows the relation between them in the e-business development life cycle. However in addition to the conceptual level of the value systems in which might be difficult to be executed for simulation, the current approaches separate these issues that

introduce the gap that gives a rise to the transitional difficulty from a value system to a process system and vice versa. We need a modelling mechanism that supports the understanding of e-business and system development. We found that the difficulty is laid by the representation of the value systems, in which the dynamic aspects of the value systems can not be captured. Since a business process is an operational system that directs the business activities in steps, the conceptual model of the value systems might not be able to reveal the insights of the dynamics in business processes. A different notion is required for value system that bridges the gap of the value system and the e-business process. The value process, discussed in the following, is proposed to this challenge for e-business modelling, and it provides the syntax and semantics of a value system to capture the dynamic nature of the e-business systems.
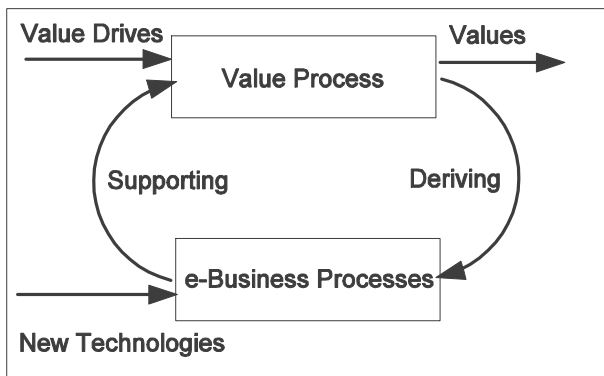

Figure 1: The dynamic relation between value process and business process.

3. PROCESS MODEL OF VALUE SYSTEM

Most of e-business modelling methods are text or graphic based that can explain the value system but provides the drawbacks in depicting the dynamics. Our modelling approach takes from the process point of view that provides the semantics of the value system in the sense of the formalisation of the value system that the modelling result can be executed for simulation. In dealing with the value process, our modelling notion adopts the process algebra for business applications such like concurrency and synchronous/asynchronous with respect to value. At the high level of value process, the primitives are agents and the interaction among them. On another hand, at the low level of value process (business process), the primitives are processes with the actions and activities in value creation.

3.1 Value Process Description

Two types of actions are 'input' and 'output' for a given 'value channel'. Let $x, y, z \ldots \in \mathbf{V}$ be a set of value objects, and $\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{g}, \ldots \in \mathbf{C}$ be a set of value channels. The prefix actions for a process are as

$\underline{\boldsymbol{a}}(x)$: The action of inputting the value x along the value channel $\boldsymbol{a}$.

$\overline{\boldsymbol{a}}(x)$: The action of outputting the value x along the value channel $\boldsymbol{a}$.

We denote the prefix action set, $\mathbf{A}_v$, which means that each action in the set is either input or output with the specified values and channels. Value process primitive P is an activity that acts on the value via the channel, and has its continuation of the process, denoted as $v.P$. In addition to the value process primitive, a set of operators expresses the composing rule of the primitives that form a complex process. Let $P, Q \ldots \in \mathbf{P}$ a process set, symbolically, the syntax rule of a value process is defined as

$$P ::= v.P \| Nil \| P + Q \| P \mid Q \| (rx)P .$$

where $v \in \mathbf{A}_v$, a prefix action of input or output. The semantics of the value process syntax are intuitively understood as follows:

- Process $v.P$ defines a process with the value action prefix and continuation.
- Process Nil defines a value process that is no longer active to its environment.
- Summation process $P + Q$ represents an alternative of two independent processes that can be selected. Either P or Q is performed by the process at a time, but not both. For instance, getting the information of a value object either by searching on the Internet or reading from a newspaper.
- Composition process $P \mid Q$ represents two independent processes that are value dependent or independent parallel processes. When dependent, the process is interacting via its channel $\boldsymbol{a}$ and value x such as $\underline{\boldsymbol{a}}(x).P \mid \overline{\boldsymbol{a}}(x)Q$, meaning that P and Q are dependent processes with respect to value prefix $\boldsymbol{a}$, P acts offering value x, and process Q performs a complementary action receiving a value for the value process.
- Restrict process $(rx)P$ means the value process restricts its process on value x.

The notation of the value process above gives the process with the value and the channel as activity parameter. It is easily extended into multi-parameters expressed as $(v_1, v_2 \cdots).P$, where $v_1, v_2 \cdots \in \mathbf{A}_v$, the syntax rule for a value process remains unchanged. The description of dynamic aspects of the value process is achieved by defining the deduction rules that govern the process at run time. Just as in the traditional process algebra, there is only one deduction operator $\rightarrow$ over process; $P \rightarrow P'$ means that P can be transformed or evolved into P' by a single computational step. In

general, the interaction between two value processes is defined according to the following inference rules:

Interaction : $\overline{a}(x).P \mid \underline{a}(y).Q \rightarrow P \mid Q\{x/y\}$.

Parallel : $P \rightarrow P' \Rightarrow P \mid Q \rightarrow P' \mid Q$.

Restriction : $P \rightarrow P' \Rightarrow (rx)P \rightarrow (rx)P'$.

Structure : $Q = P, P \rightarrow P', P = Q' \Rightarrow Q \rightarrow Q'$

The process algebra has its richness of mathematics. However we are interested in the use of the notion for value system modelling. By adopting it for the process of the value, we arrive at the value process, which we will intend to use for value system modelling.

3.1 Value Process Modelling

Based on the value process, we discuss how the notion can be used for value system and business process modeling. In e-business modeling, the value proposition is the first step getting into understanding the logics of e-business. We assume that the value proposition is articulated for use, and the information about values, actors involved, the competences and resources required of e-business are available. To represent a value system that connects these resources together, the value process is used to describe the actors and roles, and the value relationship among the actors.

A value process agent, **A**, is a value process that offers or receives the value and continues the process. We note that an agent may be a primitive value process, $\mathbf{A}(v) = v.P$ or a composed one. In general, the agent may take many parameters as its prefix actions as required, $\mathbf{A}(v_1, v_2 \cdots)$, while the value relationships are described by how the value is offered and received among these agents, and what value process are required for each agent to fulfill the value relationship.

We use the value process agent to represent the business actor. The parameters that agent takes are considered as tasks that agent will perform. An agent is an independent entity. The connection of agents is done by matching the dependency of the tasks dedicated to the agents. For example, assuming that there was three agents denoted as $\mathbf{A}_1$, $\mathbf{A}_2$, $\mathbf{A}_3$ …, each agent performs the tasks such as $\mathbf{A}_1(v_1, v_2, v_3)$, $\mathbf{A}_2(v_2, v_3)$, $\mathbf{A}_3(v_1, v_2)$, where v_1, v_2, v_3 is the task set. Then

$$\text{System} = \mathbf{A}_1(v_1, v_2, v_3) \mid \mathbf{A}_2(v_1, v_2,) \mid \mathbf{A}_3(v_2, v_3)$$

It is an abstraction of the value process system, which only states the agents and their roles in terms of tasks. Elaborating this abstraction, we can examine how agents interact by expending the value process into the details with respect to tasks that an agent performs.

For example, we can specify the channels between the agents in term of the tasks.

$$\mathbf{A}_1 \mid \mathbf{A}_2 \mid \mathbf{A}_3 \rightarrow \overline{a}(x)P_1 \mid \underline{a}(y)P_2 \rightarrow P_1 \mid P_2\{y/x\}$$

Here we assume that $\overline{a}(x)P_1 \in \mathbf{P}_1$ and $\overline{a}(x)P_2 \in \mathbf{P}_2$ are two process sets that agents $\mathbf{A}_1$ and $\mathbf{A}_2$ will carry out to fulfill their tasks. The transformation of steps indicates the processes required for the value transmission between agents. Actually, we see that the detailed value processes can be regarded as the business processes, which show how the value is processed, created and added in each process step. We do not go further for the business process here as the purpose of the value process is to model the value system. The process notion discussed in the previous section provides enough information that supports the business process development, which will be our further interests in e-business modelling.

The financial structure of the value systems is one of the important modelling issues. For a given value system, we can inspect the financial aspects of the value process by estimating the cost and revenue sources, aggregating for the overall of the agent financial performance. We do these within the value process by defining a set of value calculators that estimate the cost of each process at the modelling phase, and compute the running cost and the revenue at the simulation phase in order to estimate the profit for each agent.

$$\text{Benefit} = \text{Revenue} - \text{Cost}$$

We argue that the financial aspect of e-business model can not be measured statically. The revenue sources and costs of the value system are dependent on running the system in which the transaction is made. The value process has detailed each value transaction between agents, thus it is possible to estimating the financial aspect of the value system at the simulation phase.

To this end, we believe that business knowledge and skills in strategic analysis are the critical and the most important component for the issues such as value capturing, activity identification, partner selection and pricing in designing an e-business system [10,13]. These issues are separated from the value process since the focus of value process modelling is to exploit the ways of how the value is processed in terms of creating, adding and distributing value and revenue among business actors. Developing a value system for business innovation or a new business idea is to capture the values to the customer and customer's values, which is a very sophisticated business process. We do not concern the value capturing; rather assume that there is the related information about the values that have been identified and available for the value process. To summarise the value process modelling, the following steps are considered:

- Articulating the values for a new or innovated business idea.
- Constructing value proposition of e-business.
- Investigating the value relationships between stokeholders, partners and customers.
- Constructing the value process system for a given value proposition.
- Estimating the financial aspects of the value system.
- Revisiting the value system for value refinement if necessary;
- Developing the business process to support the value process system.

5. AN EXAMPLE

We look at an e-business "brokage model" [15], and examine the value process in the model. Then we inspect how the value is processed in the model. The brokage model has ten sub-models including Marketplace exchange, Buy/Sell fulfillment, Demand collection systems, Auction broker, Transaction broker, Bounty broker, Distributor, Search agent, and Virtual Mall. Three process agents involved in the model, namely Seller, Buyer and Broker. The "flow-graphic" of the auction broker sub-model is shown in Figure 2.
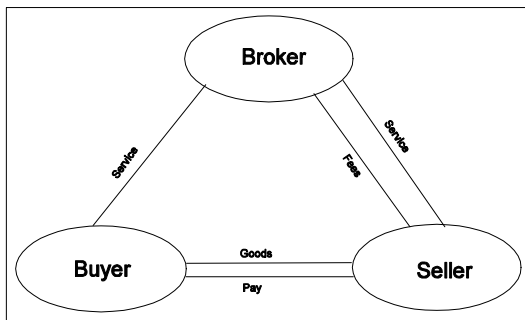

Figure 2:   An auction model of e-business

In this auction model, the "Broker" provides the Internet services that a "Buyer" or "Seller" can use for the information of the goods and buying and selling the goods. On the high level of the business description, the Broker does the activities of auction by taking the information of goods from the Seller who wants to sell and auction the goods on behalf of the Seller, it charges the Seller a listing fee and commission scaled with the value of the transaction. On other hand, the Broker interacts with the Buyer according to offering and biding rules, and finally fulfills the goods including price, delivery, etc. Three value process agents, involved in this model, are Broker, Seller and Buyer. A value set that describes the value relationship among the process agents are goods, money, service and information. Here we do not model the channels that are assumed as the Internet, and we only show the value system of auction and the business processes that the agents must perform.

The auction model is defined as

$$\text{System}_{\text{Auction}} \overset{\text{def}}{=} \text{Buyer} \,|\, \text{Borker} \,|\, \text{Seller}$$

The tasks that each agent will perform are

$$\text{Broker} = \text{Brocker}(s1, s2, lf, af),$$
$$\text{Buyer} = \text{Buyer}(s1, g, gp),$$
$$\text{Seller} = \text{Seller}(s2, lf, g, gp),$$

where $s1$ and $s2$ present Broker's offered services to Buyer and Seller respectively, and lf, af, g, gp means the listing fee, auction fee, goods, goods payment respectively.

In the auction model defined above, the system shows that the agents and the value relationship between them. Next we define the processes for each process agent:

$$\text{Borker}(s_1, s_2, lf, af) = \overline{s_1}.B_1 + \overline{s_2}.B_2 + \underline{lf}.B_3 + \underline{af}.B_4$$

$$\text{Buyer}(s_1, g, gp) = \underline{s_1}.C_1 + \overline{g}.C_2 + \overline{gp}.C_3$$

$$\text{Seller}(s_2, lf, g, gp) = \underline{s}.D_1 + \overline{lf}.D_2 + \overline{g}.D_3 + \underline{gp}.D_4$$

where B_i, $i = 1,2,3,4$, is Broker's process, C_j, $j=1,2,3$ and D_k, $k=1,2,3,4$ are the processes of the Buyer and Seller with the prefix actions specified. If an interaction occurs, for instance between Broker and Buyer, at a service step, then the system is evolved into

$$\text{Buyer} \,|\, \text{Borker} \,|\, \text{Seller} \rightarrow \overline{s_1}(x).B_1 \,|\, \underline{s_1}(y).C_1,$$

which indicates that the Broker and Buyer are interacting via the service channel. For the negotiation processes between the Buyer and Seller and negotiation service provided by the Broke, we can go further to detail the processes implementation. However, ot os unnecessary to give the trivial list of the processes.

The example of e-business modelled here by the value process shows three aspects. The value process gives the elements for the representation of the concepts of the value system, it glues the value system and business process together and the changes in the value system can be easily modelled to adjust the underlying process. The model can be simulated for reducing the risk of business development. For a particular e-business case, the value process should be made in an unique way for the competitive advantage. A value process aims at what and how the value is created for the targeted customers. The main benefit of a value process, from the competitive advantage point of view, is that it can be simulated, tested and reconfigured to meet the business strategic goals. For an identified value, how the value is processed among the business actors is determined by value-added analysis - an engineering pattern that focuses on eliminating activities that do not add value,

which has not modelled, but will be considered as our further investigation.

6. CONCLUSION AND FURTHER WORK

In this paper, we have proposed a novel e-business modeling approach. The core of the approach is a value process. The modelling approach is different to others: First it is a value driven approach concerning the values to the customer, then a value process focuses on what activities are required and how the values are created, finally the value system is configured through agents sharing the activities in the value process. We have pointed out that the business strategy is one of the most important components in constructing an e-business system. The business strategy analysis must be carried out on each phase of business modeling to build a competitive business system. An example of Brokage model is given to demonstrate the modeling approach. Our further work will be to develop a modeling environment to support the modeling methods.

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