Zheng Zhao, Virginia Dignum, Frank Dignum: Designing Business Rules for Mediation: A Process towards Agent-mediated Business Coordination. In AAAI 2008 Spring Symposium AI Meets Business Rules and Process Management, Stanford University, March 2008.

Designing Business Rules for Mediation
A Process towards Agent-mediated Business Coordination

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Abstract

Business process integration is a very active research area, in which mediation is one of the fundamental architectural choices. Mediators have difficulties to design mediation services that meet the requirements of the different stakeholders. Business rules play an important role in the decision process of mediation. In this paper, we analyze the role of business rules in the decision process, and use some examples to illustrate how business rules should be designed in order to help the decision-making of organizations.

Keywords: Agent, Mediation, Business Rules, Decision-making, Organization

Introduction

Mediated communication is one of the fundamental architectural choices for business process integration (BPI). We use the term "mediation" and "mediator" to represent mediated communication and the entity that mediates the communication respectively. These terms are derived from the verb "mediate", the meaning of which covers different disciplines such as computer science, law, and economics, which meet the requirements of our research – we should consider not only the technical aspect of BPI, but also the economic and the social aspects (Zhao, Dignum, & Dignum 2007).

In current practice, organizations (stakeholders) can hardly make any decisions of whether to use a mediator or not, because the added-values for organizations are hard to identify and estimate. Moreover, different types of mediators exist, which causes the decision-making even harder. On the other hand, mediators have difficulties to design mediation services that meet the requirements of the different stakeholders. This is because the choice of different functionalities determine the successfulness of a mediator in the market.

Several literature have argued that IT influences the way mediator (intermediary) acts: disintermediation, reintermediation, and cybermediation are all possible outcomes of the effect of IT (Malone, Yates, & Benjamin 1987) (Benjamin & Wigand 1995) (Sarkar, Butler, & Steinfield 1995) (Giaglis, Klein, & O'Keefe 2002). In order to help organizations to do decision-making, it is important to identify the situations in which mediation is an advantage (for stakeholders), and analyze the factors that influence such advantages (for mediators). Therefore, there is a need to develop a decision process that incorporates these factors of analysis, such that it can be used by organizations for decision-making.

Business rules (BRs) are the logic of business decisions. They play an important role in the decision process. They are the abstract norms of organizations that guide the decision-making.

In the decision process of mediation, the roles of BRs can be considered from two aspects, i.e. the stakeholder aspect and the mediator aspect. From the aspect of stakeholders, BRs guide the decisions of whether to choose a mediator or not, and of which type of mediators to choose. From the aspect of mediators, BRs guide the choice of which services to provide, and determine how these services should function. In this paper, we focus on the later aspect.

In the following sections, we give an introduction to our research project, show how business rules can help in the decision process of mediation (mainly from the aspect of the functionalities of mediators), design some business rules, and apply these rules to some examples in order to illustrate how they work. The last section gives the conclusions and the future research direction.

Agent-mediated Business Coordination

The agent paradigm is considered as a good way of simulating real-world applications because of the characteristics of agents, i.e. autonomous, active, proactive, and social. The agent society can properly simulate different organizations, their goals, behaviors, coordination strategies, and decision-making. In order to study the mediation process between organizations, the agent technology is chosen as the tools for simulation.

Concept of Mediation

As mentioned before, our research focuses on studying the roles of mediators in the society and the factors that influence the choice of mediation. It is important to clearly define what a mediator means in our research, and use this definition to restrict the area that we are going to study.

In order to give the definition of mediator, some concepts that are used in the definition should be given first:

- Value object: an object that has a value to its owner or to the person or the organization who wants to own it, e.g. a book, money, etc.
- Trading parties: entities who have synchronous goals of exchanging value objects with each other (they may know each other or may not) even when there is no mediator (to be defined later).
- Stakeholder: an organization or a person who is involved in using a mediator.
- Trading goal: the goal of a stakeholder to exchange value objects with other stakeholders.
- Get profits: a term that indicates to receive the return on an investment after all charges have been paid.
- More efficiently: a term that indicates one solution is better than another.

Here comes the definition of mediator. A *mediator* is an entity that provides one or more *mediation* services in between two *stakeholders* in order to *get profits* by providing these services, in which *mediation service* is defined as:

Service that

- acts between *trading parties* to make the goal of exchanging *value objects* achievable or to help them to achieve their *trading goals more efficiently*, or
- provides information to a stakeholder who asks for information of (products of) other stakeholder(s) according to the stakeholder's query, or
- disseminates information of one stakeholder to other stakeholder(s).

At the current stage of our research, we assume there are only three parties involved in mediation, i.e. the buyer, the mediator, and the seller.

Business Rules and Mediation

In mediation, complex business processes are involved between organizations. Business rules are the core elements of the mediation architecture that provide guidelines of the coordination and guarantees the proper execution of the process integration.

The Business Rules Group (TheBusinessRulesGroup 2000) defines a business rule as a statement that defines or constrains some aspect of the business. It is intended to assert business structure or to control or influence the behavior of the business. The business rules which concern the project are atomic (i.e. they cannot be broken down further).

Furthermore, the business rules are viewed from two perspectives, which are the business perspective and the information system perspective:

- From the business perspective, a business rule is guidance that there is an obligation concerning conduct, action, practice, or procedure within a particular activity or sphere. It pertains to any of the constraints that apply to the behavior of people in the enterprise.
- From the information system perspective, it pertains to the facts which are recorded as data and constraints on changes to the values of those facts. A business rule expresses specific constraints on the creation, updating, and removal of persistent data in an information system.

Business rules are the logic that drives business decisions. A business decision is, in essence, a business judgment made about a business concept or some attribute of the business concept (Goldberg 2007). This judgment is made based upon the business rules that underlie the business decision, which is the principal means by which business rules are implemented in the business.

Defining business rules explicitly gives the guidelines of decision-making, and helps to automate the process of decision-making. In the decision process of mediation,the existence of business rules increases the insight of the process and gives the ability to handle the decision complexity.

The decision process of mediation can be viewed from two aspects, one is the stakeholder aspect, and the other is the mediator aspect.

From the perspective of stakeholder, organizations need to make decisions on whether to use a mediator or not, and on which mediator to use. For different situations (i.e. different organizations have different properties), pre-defined business rules which are separated from the situations can be applied when the conditions of these rules are satisfied.

From the perspective of mediator, organizations need to choose which services (functionalities) to provide in order to meet the requirements of their stakeholders. The decision should be made based on the type and the demands of the corresponding stakeholders, as well as the business rules that guide the matching of demands and services.

Mediators and their Functionalities

Mediation is a process that describes the business activities involved among the communication of three parties (under our assumption), a mediator and two stakeholders. Without the needs in between two stakeholders, the services provided by mediators are meaningless. Therefore, the added-value services of mediators should be identified based on the demands of stakeholders. However, how these services show up depend on the underlying business rules that guide the concrete execution of these services. Thus, business rules determine the functionalities of mediator.

The Added-value Services of Mediator

The demands of stakeholders can be considered from three dimensions, which are *uncertainty*, *lack of capability*, and *unwilling cost*. In each dimension, there exist certain types of limitations of stakeholders, which are the cause of the appearance of the services of mediators.

Dimension 1: Uncertainty When there are uncertainties of doing something or about something, it is risky to continue or make predictions of the current ongoing. Moreover, if the degree of uncertainty is higher than an acceptable threshold, there is a need to get external help in order to reduce such uncertainty.

Three types of uncertainties of stakeholders are distinguished, which are *information uncertainty* (i.e. information asymmetry, information overload, and lack of information), *level of trust uncertainty*, and *profit uncertainty*.

Accordingly, the added-value services of mediator can be identified as

- negotiation,
- information searching,
- information aggregation,
- neutral trust third-party, and
- profit guarantee.

Dimension 2: Lack of Capability When stakeholders have a lack of capability, goals become hard to be achieved or even unachievable. Three types of limitations in this dimension are distinguished, which are *knowledge limitation* (e.g. lack of expertise), *location constraint*, and *constraint of information dissemination*.

The services of mediator can correspondingly be identified as

- providing expertise,
- providing (physical) communication platform, and
- advertising.

Dimension 3: Unwilling Cost For each stakeholder, there exist certain types of cost that are not willing to be dealt with. Different types of costs are distinguished, which are *time cost*, *effort cost* (including mental effort and physical effort), and *money*.

Correspondingly, the possible added-value services of mediator can be classified as

- saving time,
- saving effort, and
- saving money.

The choice of services that a mediator can provide depends on the stakeholders in between which the mediator acts. On the other hand, when do stakeholders choose a mediator, and which types of mediator do they choose depend on the properties possessed by the stakeholders themselves, as well as the functionalities of mediator.

The Role of Business Rules

Business rules determine the functionalities of mediators. They are the guidelines of how services should function. For example, Google and Baidu.com (the first Chinese search engine) are two search engines that have different background, due to which, they follow different business rules (Google provides any searching results based on the query; while Baidu.com may give results under the consideration of the Chinese policy). Because of this, the outcomes of the service they provide are different.

In order to illustrate this, let's compare the searching results given by Google and Baidu.com on a sensitive subject *Human Right* (searched in Chinese characters). The searching results given by the two mediators are different considering from three aspects:

- the different index sites,
- the different ranking of the same site, and
- the different abstract description of the same site.

Since there are too many searching results, we only compare the results appeared on the first page of the two search engines. Some sites indexed by Google are not listed on the page of Baidu.com (e.g. Wikipedia). The position of the site http://www.un.org/chinese/hr/ appeared on the resulting page are different. Moreover, the abstract descriptions of this site given by the two mediators focus on different directions.

Designing Business Rules for Mediation

Business rules can be considered as the way of requirement engineering for mediation. They help organizations to achieve goals by putting constraints on the execution of concrete processes, such that the execution can meet the requirements of customers and organizations.

In mediation, the demands of stakeholders guide the service directions of mediators, while business rules show the way that can lead to the successful execution of these services. As analyzed in (Zhao, Dignum, & Dignum 2007), in order to study the roles of mediator, we need to consider not only the technical aspect, but also the economic and the social aspects.

For example, a company needs to purchase goods from some other companies. Several suppliers provide the required goods with different prices and qualities. These suppliers located in different countries.

Considering the potential existing risks from the economic aspect, the company that needs to do purchasing may have BRs as for example:

- The quote of product should be compared among at least three suppliers before purchasing.
- Never make all purchases from one single supplier.
- Purchase goods from the supplier that is located close to the company.

Considering from the social or the normative aspect, suppliers may have the rules such as:

- The payment must be received within one week.
- Products must be delivered within three days.

For the customer company, the rules can also be used as the guidance of making decision of which suppliers to choose. While for the suppliers company, meta-rules that are used to define the performance of the company should exist in order to increase the business opportunities.

Another example that illustrates how business rules help in decision-making is as follows: suppose Zheng wants to sell a house, but she doesn't know people who want to buy a house. However, she knows that a housing agency named Easyhousing knows some people who want to buy a house. Some business rules can give Zheng possible solutions if the case description can be formalized and match the preconditions of the rules.

Semantic Web Rule Language (SWRL) is one of the representation forms of business rules. It is a standard rule language that can be used by different applications.

Let's define a business rule using SWRL that describes the following situation: *stakeholder s1* has a value object, and he wants to sell this value object. But he doesn't know a *stakeholder* (let's say *s2*) who wants to buy the value object. However, he knows *mediator m1* and he knows that *mediator m1* knows *stakeholder s2* who wants to buy the value object. Therefore, *stakeholder s1* goes to *mediator m1* to ask for help.

The described rule is formalized as follows:
$ExVOStakeholder(?s1)$
$\bigwedge hasVO(?s1, ?vo1)$
$\bigwedge willSell(?s1, ?vo1)$
$\bigwedge ExVOStakeholder(?s2)$
$\bigwedge willBuy(?s2, ?vo1)$
$\bigwedge notKnow(?s1, ?s2)$
$\bigwedge Mediator(?m1)$
$\bigwedge knows(?s1, ?m1)$
$\bigwedge knows(?m1, ?s2)$
$\rightarrow gotoMediator(?s1, ?m1)$

Let's formalize the selling house example as:
$ExVOStakeholder(Zheng)$
$\bigwedge hasVO(Zheng, House)$
$\bigwedge willSell(Zheng, House)$
$\bigwedge ExVOStakeholder(Buyer)$
$\bigwedge willBuy(Buyer, House)$
$\bigwedge notKnow(Zheng, Buyer)$
$\bigwedge Mediator(Easyhousing)$
$\bigwedge knows(Zheng, Easyhousing)$
$\bigwedge knows(Easyhousing, Buyer)$

By applying the given rule, we can have $gotoMediator(Zheng, Easyhousing)$ which indicates that Zheng can go to the housing agency Easyhousing to ask for help.

Intelligent Agents and Business Rules

Agents are intelligent entities that can interpret business rules, and use them as the guidance of their own behaviors. The key aspect in the definitions of agent is *autonomy*, which refers to the principle that agents can operate on their own, without the need for human guidance (Wooldridge & Jennings 1995).

Agents in an organization retain their autonomy, while on the other hand, follow the organizational rules. Organizational business rules act as the constraints that are added on the behavior of the agents, which guide the direction of the agents' decisions.

Business rules represent the abstract norms of an organization, which are independent from the agents that will use these rules. As long as the business rules are abstract enough, agents are capable to interpret the rules and apply the rules while deliberating.

In order to see how agents interpret and apply business rules, let's look at an example. Suppose a supplier company has the business rule *products must be delivered within three days*, the agent that is responsible for delivery should then keep this in mind. Since agents are autonomy, different agents may act vary in order to assure the ordered products are delivered within three days. For example, *Agent A* may check the product delivery everyday to see whether they are delivered, if they haven't yet been delivered he will send a reminder; *Agent B* may keep the work in mind and check the product delivery on the last day, if they haven't been delivered he will deliver the products himself.

Conclusions

Business rules are the logic of business decisions, which guide the decision-making of organizations. BRs play an important role in both aspects of the decision process of mediation, which are the aspect of the choice of mediation, and the aspect of the functionalities of mediators, respectively. We focus on the later aspect in this paper.

Intelligent agents can interpret BRs and apply them to their own deliberations. The study of BRs in mediation is one of the steps towards the research on agent-mediated business coordination. The designed business rules will be further used by agents that simulate organizations in the process of mediation.

The future design of the business rules will be based on the analysis of the roles of mediators and the influencing factors in mediation. The representation form of business rules and how agents interpret the BRs in the simulation still need to be further developed.

Acknowledgments

This research is supported by NWO, under the project "Agent-mediated Business Coordination".

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