Abstract

Attempts to develop open process standards, such as Rosetta Net, have had limited success in finding wide-spread adoption. Standardization of interorganizational business processes, previously viewed as aiding interorganizational collaboration, is shown to impede that collaboration in service contexts. We show that the modeling methods used to standardize inter-organizational processes fails to account for the impact such standardization has on managerial flexibility. Service production often involves co-production between consumer and producer, which gives rise to greater uncertainty in the ordering of work tasks. Due to this uncertainty managerial flexibility is highly valuable in services. This uncertainty gives rise to an explosion in the amount of possible production sequences. Decision making biases make coordination between organizations difficult because decision makers do not appreciate the magnitude of the flexibility loss arising from adopting business process standards. It will be shown a different approach to modeling processes is needed in a service context.

Introduction

Computing standards organizations, like Rosetta Net, have tried for years to develop interorganizational process standards with little success outside the IT manufacturing industry that initially established the organization. The practice of process standardization has a number of benefits. By standardizing processes a set of firms can all try to implement best practice procedures. Suppliers and businesses know what to expect. Those carrying out the processes can concentrate on improving the process using a standard quality management toolset. Research has found that process standardization is necessary prerequisite for business improvement through software (Maidantchik, et. Al.,
In spite of these apparent benefits the lack of success of electronic process standards, such as Rosetta Net, suggest that standardization might not be as beneficial as prior research suggests. Workflow modeling technology is used by frameworks, such as Rosetta Net, as the language to express the processes. It will be shown that: 1) there are important process differences between service production and traditional manufacturing, 2) that these differences lead to uncertainty as to what the steps of a production process will be, 3) a flexible production process is desirable in a service context due to this uncertainty, 4) cognitive biases are such that individuals systematically underestimate the solutions to certain classes of mathematical functions, 5) the mathematics of process sequencing is such that a process modeler underestimates the flexibility loss arising from the use of the current workflow tools due to systematic cognitive biases, and 6) a more flexible workflow modeling framework is needed to standardize processes in services.

RosettaNet is a computing standards organization that defines interorganizational process standards for member organizations. RosettaNet offers standards for implementation frameworks, business message schemas, process specifications using workflows, and data dictionaries. The process standards used by RosettaNet follow the standard workflow framework established by the Workflow Management Coalition (Piccinelli, et. al., 2002). While RosettaNet has been primarily adopted by electronics manufactures, some processes have been explicitly designed for customer service activities (RosettaNet Consortium). While RosettaNet would seem to have advantages that would lead to widespread adoption, but the consortium has seen little membership growth outside electronics manufactures (Damodaran, 2004). The question for this paper
is why do process standardization organizations, like RosettaNet, have such low participation rates if process standardization is beneficial?

As economies develop, service work plays a greater and greater role. In this paper I adopt the common definition of a service as “a useful labor that does not produce a tangible commodity”. Service industries include trade industries, transportation, information/cultural industries, financial services, professional/scientific/technical services, support services, education, healthcare, social assistance, arts, entertainment, recreation, accommodation, and (US Census Bureau, 2002). Among modern industrialized nations it has been shown that service work exceeds manufacturing work in both dollar and employment level terms (BLS, 2005). Service work is only expected to grow in the future. Services differ dramatically from manufacturing because of the nature of production in a service context is inherently different from production in a manufacturing context. Services exhibit the characteristics of intangibility, inseparability, and heterogeneity. Intangibility refers to the idea that services cannot be inventoried, are not readily measured, and they do not even consume physical space (Shostack, 1977). Inseparability refers to the idea that the consumption of a service and the production of a service often occur simultaneously (Carmen and Langeard, 1980). Service production is often inseparable from consumption to such a degree that the consumer rises to the level of co-production (Parasuraman, et. al., 1985). Heterogeneity refers to the idea that services often vary from day to day and customer to customer (Parasuraman, et. al., 1985).
Services and manufacturing are different in that in a service context the customer supplies key inputs to the production process (Brown, et. al. 2002). For example, a customer usually needs to tell the service provider how to cut his/her hair when getting a haircut. The psychotherapy patient that does not talk to the therapist is not likely to find the process therapeutic. Co-production of output that is common in services necessitates a high degree of cooperation between consumer and producer. In service industries the production process is highly contingent upon the specific interactions of consumers and producers, which implies far greater uncertainty a priori in the sequence of events necessary for production of services. As a result high degree of uncertainty results from the co-production found in services (Argote, 1982; Jones, 1987).

The heterogeneity inherent in service processes manifests as variety that can be seen as a sign of the flexibility that is necessary for high quality (Feldman, 2000). In a manufacturing environment, in contrast, variation in the sequence of tasks used in production is seen as indicative of poor quality (Oakland, 1996). Empirical work on task sequencing has observed a high degree of variety in service settings (Pentland, 2003). Previous studies have shown processes to be a potential source of flexibility in organizations (Feldman and Pentland, 2003). Increasingly, information processing involves the use of workflow management systems, which are being used to define work processes in service industries (Fletcher, et. al., 2003). The ability of a service provider to deal with a wide variety of situations is a mark of high customer service (Zeithaml, et. al., 1990; Cronin and Taylor, 1994) and a key factor in retaining customers in service environments (Keaveney, S., 1995). Service workers must be capable of developing
novel solutions to the often unique situations they often face. A great deal of uncertainty results from this uniqueness often requiring a great deal of information processing and a high level of IT capital (Bowen and Ford, 2002).

**Theoretic Development**

In order to understand how the uncertainty in service production relates to standardization and how this relation is unlikely to be detected by managers it is necessary to codify what is meant by both standardization and flexibility. Workflow modeling tools common in practice today results in a large loss of flexibility. It will be shown that this flexibility in task sequencing is a combinatorial function of the number of tasks. Combinatorial functions concern the mathematics of combinations and grow at a rapid rate. This loss of flexibility is further compounded when the tasks of a process are assigned in an interorganizational context. Workflow technology in use today has been shown to be inadequate for addressing all the situations that may need to be modeled (van der Aalst, et. al., 2003). Current technology works by relaxing constraints on a single sequence model to explicitly specify the paths that are valid. In today’s environment process models, produced using workflow tools modeling tools, starts by specifying a single most likely task sequence. After specifying this most likely task sequence, the process modeler relaxes this full constrained model by allowing for exceptions to the most likely task sequence. A production sequence is referred to as fully constrained when there is one and only one task sequence, this is opposed to a fully open model where the task can occur in any order. It will be shown that relaxing constraints on a fully
constrained model, rather than constraining a fully open model results in an unexpected loss of necessary flexibility.

To develop an interorganizational process one must: a) determine the order the tasks are to be completed in and b) who or what is to complete the task. Interorganizational process can be viewed as containing two problems 1) a task-sequencing component and 2) a task assignment component. Task-sequencing refers to what order the tasks are to occur in the process. It will be shown that both of these components offer a large number of possible options, representing flexibility for an organization. We will first address the implications, in flexibility terms, arising from task-sequencing and then address those arising from task-assignment.

Given that service contexts have been shown to exhibit a great deal of variety, one would expect that $K$ is relatively large in most effective service organizations. Assuming that $k$ is relatively large in most service organization, coordinating processes interorganizationally adds a layer of complexity in that there must be agreement upon a feasible task sequences among organizations. Now consider the number of ways to order $n$ number of tasks. The permutations, the possible combinations of task sequences, of $n$ number of tasks is

$$N!$$

Now consider that we implement the inter-organizational process using workflow systems which constrains the workflow to one task sequence. In this case by constraining the workflow to one sequence the loss of sequences is
Consider that management imposes what appears to be a restriction, say task A must be done first. This case results in a loss of

\[ N!-(N-1)! \]

task sequences available to management. In this context if each task is to be done once and only once in each production sequence the number of possible sequences is a factorial function of the number of task to be completed, if a given task can appear in a sequence more than once this only greatly compounds the number of possible sequences. We can see from this that even apparently insignificant restriction result in large losses in flexibility.

Next we must address issues concerning task-assignment. The number of ways to assign \( T \) tasks between \( O \) organizations is

\[ O^T \]

To illustrate these concepts consider an example process with 4 tasks, A through D, and three organizations. Assuming the tasks are always sequenced A-B-C-D, how many more scheduling options does the interorganizational system with 3 organizations have that a system with one organization?
<table>
<thead>
<tr>
<th>Task</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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</thead>
<tbody>
<tr>
<td>Option 1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Option 2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Option 3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
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<tr>
<td>Option 4</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Option N-1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Option N</td>
<td>3</td>
<td>3</td>
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<td>3</td>
</tr>
</tbody>
</table>

Because of the scheduling effects the number of options $\gamma$ available to management with $O$ organizations and $T$ tasks is

$$\gamma = O^T - 1$$

So the total number of possibilities $\gamma$ with $T$ tasks and $O$ organizations is

$$\gamma = T!O^T$$

To see how the two effects work it is useful to consider an example with a relatively small number of tasks and organizations. Consider a 7 task work process with 4 organizations. This leads to $7!$ (5,040) number of task sequences, $4^7-1$ (16,363) number of possible task assignments for a total number of possibilities of 82,570,320!

Once the combinatorial nature of interorganizational processes is understood it is then necessary to examine whether managers are likely to realize it. Individuals have been shown to drastically underestimate the number of possibilities resulting from combinatorial functions due to cognitive bias (Tversky and Kahneman, 1973). Cognitive bias of imaginability is a sub category of a larger class of biases known as biases of
availability (Tversky and Kahneman, 1974). Availability biases have been shown to be widespread in a number of different populations. These cognitive biases have been shown to lead to adverse economic consequences in terms of risk-aversion and overweighting low probability events (Kahneman and Tversky, 1979).

**An Example**

To illustrate this point, consider a travel agent as an example. The hypothetical travel agent performs four tasks: lodging, car rental, airfare, and also finds tickets to attractions such as local museums or sporting events or other such attractions where tickets are scarce and often purchased in advance. The travel industry makes a good example in that it has been shown that customer service is especially relevant in this industry (Murphy and Tan, 2003). Next consider a given travel agent adopts a standardized process which constrains the process to the following order: 1) select airfare, 2) select lodging, 3) select rental car, and 4) select attractions. The travel agent is adopting the process standard because the various partners used to the book the various items, within the industry are moving to the standard. While on the surface this constraint may not seem unreasonable, consider the impact on the flexibility that is needed in the industry. Consider a couple planning a vacation to Scottsdale, Arizona. First and foremost, the couple wants to visit a particular spa and a particular golf course. The couple wants to rent a convertible. They would like to upgrade to a mountain view room, but not exceed their strict budget. The couple has no preference on airline. The entire trip is contingent upon getting reservations at a particular spa and a tee time at a particular golf course. The budget for the hotel room is contingent upon what is spent on the spa, golf, and rental car. The problem with the
constraint placed upon this system by the process standard is that it does not allow the
couple to first book the attractions which determine what occurs in the rest of the process.

Discussion

Current technology works by relaxing constraints on a single sequence model to
explicitly specify the paths that are valid. Kumar and Zhao (1999) proposed a modeling
framework, Process Constraint Language (PCL), which works by constraining a fully
open model. In this context a production sequence is allowed by the workflow system if it
is consistent with employee or management understanding of how a process could be
done, that is to say the sequence does not violate any expressed or implied business rules
(Kumar and Zhao, 1999). By specifying what is invalid PCL minimizes the loss of
flexibility and thus seems a far more appropriate approach to modeling service processes.
We show how an approach such as PCL address assumptions in current workflow
technology that impact the ability to coordinate service processes and are a far more
appropriate means from which to develop process standards in services.

This study has several important implications for both managers and researchers. For
managers it is shown that the business impacts of adopting interorganizational process
standards in a service may be very different the business impact in a manufacturing
context. Managers should carefully consider how such standards will impact the
flexibility that is much needed in a service context. This study also reinforces the general
idea that the production process in services is often very different from that in
manufacturing. These differences are especially relevant in services given the often important role of information technology in service provisioning.

For researchers this study provides some important insights as to both the potential impacts of interorganizational process standardization and a general framework for looking at processes in a service context. It is shown that process standardization, normally thought to be a positive thing, actually leads to a loss of much needed flexibility in service contexts. This study is not without limitations. First, many businesses are neither pure service contexts nor pure manufacturing contexts. As an example, in food services many restaurants produce goods that can be inventoried using a doggy bag. Also, most manufacturing companies need to provide customer service support. Exactly what the implications of standardization are in a hybrid case needs further examination. Second, the paper did not include empirical examination of the ideas proposed and the idea could generally benefit from empirical examination of what is occurring in the field. This research opens up many avenues for future research. First, empirical research could be conducted to test the impacts of adopting process standards in service contexts. Empirical research in this area could take several forms from archival-based econometric study to a highly imbedded case study. The theory suggests that service firms adopting process standards should perform worse that those that do not. Experiments could be conducted to see if managers do in fact underestimate the loss of flexibility arising from standardization. Second, there is potential to use the ideas presented in this paper to develop a new modeling methodology specifically designed for interorganizational processes in service organizations. Finally, a researcher could develop valuation tools
using real-options to help managers access the financial impact of the flexibility losses outlined in this paper.

**Conclusion**

Standardization of interorganizational business processes, previously viewed as aiding interorganizational collaboration, is shown to negatively impact that collaboration in service contexts. Modeling methods used to standardize inter-organizational processes does not account for the impact of standardization on much needed managerial flexibility. The co-production between consumer and producer in services gives rise to greater uncertainty in the sequence of production, making flexibility more valuable. The uncertainty inherent in services gives rise to an explosion in the of possible production sequences. Coordination between organizations becomes very difficult using process modeling paradigms imbedded in recent attempts at standardization. By using a different modeling framework, such as PCL, to modeling processes in a service context coordination become much easier.
Work Cited

18. Software process standardization for distributed working groups


