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Abstract

We have modeled a sales opportunity management process of an IBM business division using an operational process specification methodology. The modeling approach, OpS (Operational Specification), factors the knowledge about the business operations into Information, Function and Flow components, and enables the analysis to identify process improvements. Some results of simulating this model are also presented.

Keywords

Business Process, Modeling, Simulation, Opportunity Management

1. Introduction

In today's competitive and dynamic business environment, managing a sales opportunity in timely manner is critical for survival. An IBM business division encounters hundreds of business opportunities each day for selling computer products to organizations of various sizes. Each opportunity has to be carefully evaluated in terms of future business potential, technical feasibility, competitors' bid prices, and supply chain status. A competitive bid price has to be decided and communicated to potential customers promptly to have a chance to win the opportunity. The ability to generate a winning bid hinges on the capability to price the opportunity profitably and competitively, in a timely manner. In this case the process of managing an opportunity used to take many hours or even days depending on the complexity of the opportunity. The division was motivated to analyze and improve the opportunity management process. The goal is to make necessary process changes in order to shorten the processing time substantially to be competitive in the marketplace.

We have modeled the opportunity management process using a business process modeling methodology developed at IBM Research, called Operational Specification (OpS) [1,2]. This approach helped us in identifying the opportunities for process improvement. OpS is a technique for capturing a complete operational description of a business. OpS is based on a factorization of operational business knowledge into Information, Function and Flow components. A key differentiation of OpS is that it relies on explicit knowledge about business-sensible information chunks.

The models we have developed to describe the alternate business processes were simulated for various scenarios, using process parameters such as cycle time, resources and alternate process configurations. The simulation study indicates that a substantial improvement, especially in the overall process cycle time, can be achieved by the process changes.

2. Operational Specification Modeling Methodology

In this section we provide a concise introduction to the Operational Specifications (OpS) approach. The key components of OpS are:

- *[Information]* Explicit information is represented as **artifacts** or business records. Artifacts provide the underpinning to everything that happens in the business. Artifacts have identity, are self-describing and self-sufficient, and are persistent. Everything that is of concern to the business needs to be recorded on some artifact in the business.

- *[Function]* Business **tasks** encode how an artifact is modified, using perhaps information from other artifacts, in the course of what the business does. The granularity of a task is a business decision.
- *[Flow]* In order to provide a complete operational model of a business, we need to construct the life-cycles of all the artifacts in the business. The **connectors**, think of these as pipes through which the artifacts flow, constitute the key element along the flow dimension.

Imagine artifacts to be akin to pieces of paper where appropriate business information has been recorded. Now consider each task to be performed by a person, working in a cubicle. Each cubicle has an in-box and some number of out-boxes. An artifact appears in an in-box. The person in the cubicle, picks up the artifact from the in-box and does one of the following:

- If the artifact is recognized as one that the person has been trained to work on, then the person adds as much information as s/he can to the artifact. The precise information added depends on the training e.g. use reference materials such as rules and guidelines, consult the customer etc. Once finished, the person places the artifact in one of the out-boxes, depending on how much information has been added.
- If the artifact is not recognizable, then s/he places the artifact in a designate out-box (corresponding to "don't know how to handle this")

All that remains to complete the operational description of the business is to arrange for "runners" who will move artifacts from a specific out-box to a specific in-box. This part will be orchestrated and managed by the overall person in-charge of the piece of operation being modeled. The essence of the OpS approach is to construct the life-cycles of all the artifacts of the business i.e. how each artifact is processed from creation to ultimate archival.

2.1 Artifacts

As the central information concept in OpS, an artifact is an explicit business record. Some properties to be kept in mind are:

- It is a collection of information that stands on its own and has direct business
- It has unique identity (an ID)
- It is *immutable* i.e. cannot be split into pieces
- Arbitrary amounts of diverse information can be added to an artifact as the business desires

2.2 Tasks

Each step in this lifecycle is modeled as a task. A task works primarily on one artifact though it may need to update other artifacts on an "as needed" basis. A task is not well formed if it does not have an artifact to work on. A task accomplishes its processing goals by adding information to the artifact(s) that it is working on. A task can be started by one of the following mechanisms:

- *By receipt of an artifact:* there are two possible cases here. Either the artifact arrives spontaneously i.e. appears in the worker's in-box or worker has posted a request for an artifact with specific characteristics, and is waiting for it. In both these cases the task starts with an artifact to work with. Of course the task may need to request or create additional artifacts as well.
- *By a receipt of a "message":* it is a premise of OpS that a business does not send its artifacts beyond its span of control. Consequently interactions with external agents e.g. other businesses are through messages. An example of such triggering might be the receipt of a phone call from a Customer.
- *By a " person" or by a "timer":* some tasks need to be started explicitly by a person e.g. by clicking on a button in a user-interface or by swiping a card, or performed periodically e.g. every fifteen minutes.

A repository is a collection of artifacts; OpS does not provide a corresponding construct for messages. Despite the choice of name, a repository should not be thought of as database-like. Rather, a repository should be thought of as a Task that does not modify the artifacts that pass through it. Tasks can "push" artifacts into and "pull" artifacts from a repository; these are the only operations on a repository.

2.3 Connecting Tasks

The best way to think of connectors is as pipes that connect two tasks, and that artifacts or messages flow through these pipes. The connection points on tasks and repositories are called Ports. The semantics of a connector are quite simple - an information package placed on one end (i.e. the From Port) of a connector will eventually delivered unchanged to the destination (i.e. the To Port). Moreover the two ports at the end of the connector must agree on the nature of the interaction i.e. both are Spontaneous or Request-Response or Protocol.

Each kind of connection serves a purpose, as per the scenarios discussed below:

- *A task has finished processing and the resulting artifact needs to be placed in a repository:* artifact transport connector from the output port of the task to the input port on the repository
- *A task needs to refer to the content of an artifact in a repository:* message transport connector from Repository to an input request-response port on the Task
- *A task needs to obtain possession of an artifact in a repository:* artifact transport connector from Repository to an input request-response port on the Task
- *A task starts working when an appropriate artifact is available in a repository:* artifact transport connector from Repository to an Input Trigger port with Request-Response interaction

3. Modeling of the Opportunity Management Process

The scope of the business process modeled in this work is from the step where a customer communicates a bid opportunity to the business division, till the customer accepts the bid and a fulfillment unit is ready to process customer order. The business at hand is characterized as end-to-end processing of a single kind of artifact or business record, in this case, the Opportunity. The OpS model consists of a network of tasks that create the artifact and add information to it, till the artifact has been processed fully and is archived. Of course other processes, such as Order Processing, that are not described here, will utilize this artifact as part of their operation.

The diagram below, Figure 1, is a simplified, birds-eye view of the Opportunity Management process. However, certain shapes are discernible in the diagram and so is the general pattern of interconnection. The operational description consists of the Opportunity artifact flowing from left to right, except for the loops as indicated. A brief description of the constructs discernible from this diagram follows:

- [*Rectangles with Rounded Corners*] **Business Tasks**: define a "business sensible chunking" of function; information (artifact or message) needed to accomplish the processing flows into tasks through a variety of ports with appropriate semantics
- [*Dashed Shaded Rectangle*] **Process Abstract**: indicates a process on which there is a dependency i.e. it is to provide an artifact or its content but the process itself is not in scope of the model
- [*Large Circles*] **Repositories**: are just collections or wait shelf where an artifact is placed. These are used either as wait-shelves where the artifact is placed temporarily or as archival collections
- [*Solid Edges*] **Transport Connectors**: are pipes through which artifacts flow
- [*Dashed Edges*] **Message Connectors:** are pipes through which messages or artifact content flows
- [*Stick Figure*] **External Agent:** is outside the business i.e. it does not have access to the actual artifacts of the business.

In the OpS model of the process we have developed so far, we have three artifacts that capture the operational view of the business. In other words, the operational process we describe "is in the business of processing" the following artifacts:

- **Opportunity** (Folder) – this is the key artifact for our scope
- Request for Customer Assurance/Activation/Contract (contains all the information to check customer, and to build contract if it doesn't exist yet.)
- Request for Fulfillment Activation (contains all the information needed by the Fulfillment Process)

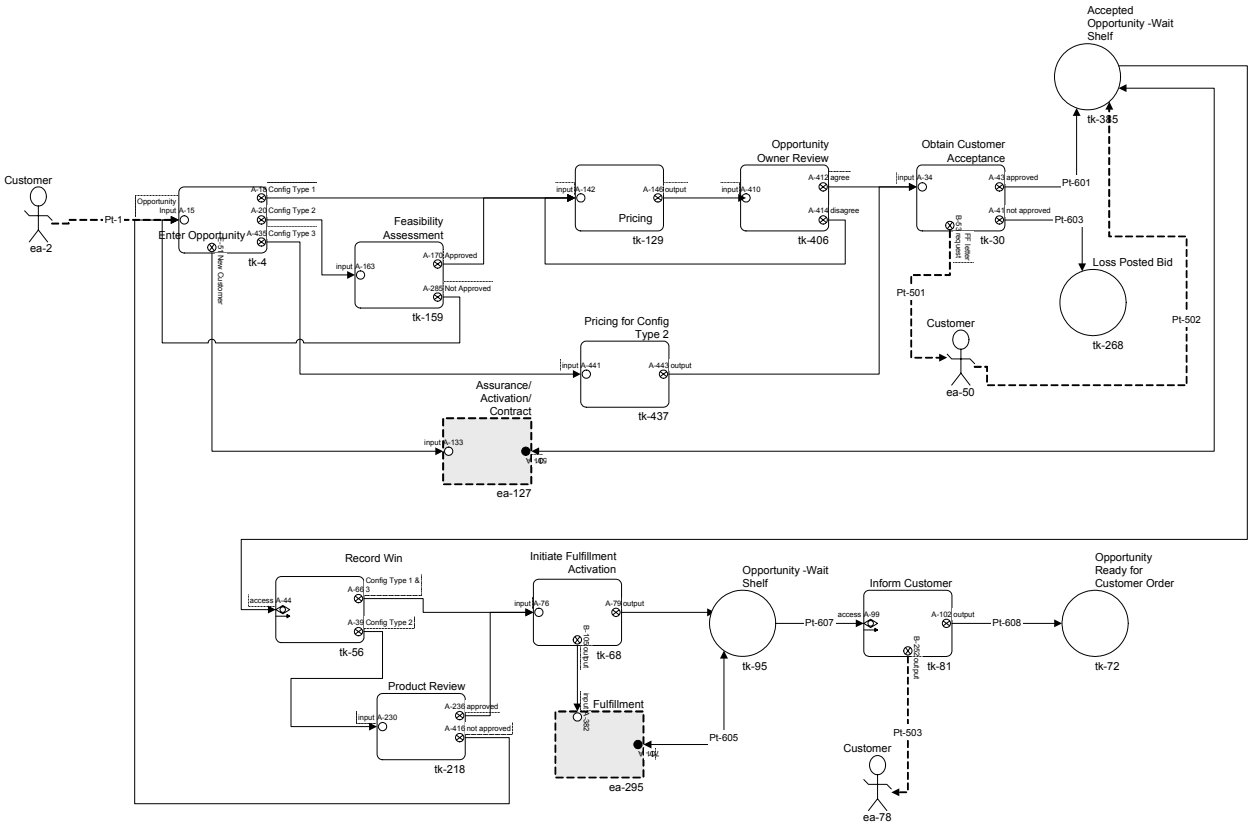

Figure 1. OpS Model of the Opportunity Management Process

The Opportunity flows left to right through the network of tasks. This is depicted in model by transport connectors and is shown in the diagram as horizontal solid directed edges. Each task adds one or more pieces of information to the artifact.

The ports on the tasks are the points at which information enters or leaves the task. The ports along the east edge of the task are usually the output ports (*circle-with-a-x)*. The model has details of what information an artifact must contain in order to be recognized at an input port (*circle)*, and the information an artifact is guaranteed to contain when it is emitted from an output port. If a task has two output ports, the artifact can only come out through one of them. For example, the task **Enter Opportunity** has three output ports which are labeled as "Config Type 1", "Config Type 2" and "Config Type 3". This task receives opportunity information from a customer, creates the primary artifact called "Opportunity", and adds configuration information to it. Based on this configuration information, that artifact comes out through one of the three ports on the task.

There are three significant loops that capture the following situations:

- For an Opportunity that requires a "Config Type 2", the "Feasibility Assessment" task may decide that a configuration type 2 is not warranted; in this case the Opportunity is returned to the Opportunity Owner in the "Enter Opportunity" task
- If the Opportunity Owner disagrees with the pricing, s/he can return the artifact to the Pricing task (a kind of appeal)
- For an Opportunity that requires a "Config Type 2", after "Record Win" task, the "Product Review" task needs to re-examine the opportunity to ensure that the configuration can be built with the price, and if s/he does not approve, the artifact can be sent back to the Opportunity Owner

Let us examine how dependencies between tasks are described through artifacts. The "Initiate Fulfillment Activation" task creates a Fulfillment Activation Request artifact and sends it out on the port on the south edge, and it records this fact ("FF Request has been sent") on the "Opportunity" and sends the Opportunity on the output port (east edge). How the Fulfillment process works on the Fulfillment Activation Request is not detailed, since that is not in our current scope. However, we do show that once Fulfillment has processed the activation request, it will fetch the Opportunity from the Wait-Shelf (repository) and record the fact that "FF has been activated" on the artifact, and return it to the Wait-Shelf (*bi-directional solid edge)*. The "Inform Customer" task waits till there is an Opportunity on the Wait-Shelf that has information indicating that "FF has been activated". This task extracts this Opportunity from the Wait-Shelf, informs the Customer that we are ready to take orders, and sends the artifact to the archival repository.

The process model presented here was further extended to include information technology (IT) components that are involved in the process to study how IT systems resource and performance affect the overall processing time. The details of the IT extensions will be discussed in a subsequent paper.

4. Simulation Results

We modeled several operational variations of the process and simulated various scenarios using different process parameters such as cycle time and resources. IBM is currently developing a simulation tool which integrates the OpS modeling methodology; however, the tool is not yet available. We conducted our simulation work using a IBM's business process modeling and simulation tool, Holosofx. The OpS model described above was converted to Holosofx for the simulation. For each scenario, we analyzed queues (maximum, average and duration) on each tasks to identify bottlenecks that contribute the overall process cycle time. When unreasonably long queues were noticed, we tried to reduce the queues by adding more resources to the involved tasks or by modifying the process configuration. For a particular simulation scenario, the computed task queue is summarized in the Table 1, where noticeable queues are observed in the "Pricing" tasks. In this case, adding more resources, i.e. pricing specialists, can substantially reduce the cycle time. In other cases, a bottleneck can be resolved by changing the process configuration, rather than by adding more resources.

Table1. Simulation Result: Task Queue

Tasks	**Max. Queue**	**Avg Queue**	**Avg Duration (hours)**
Enter Opportunity	0	0	0
Feasibility Assessment	1	1	0.01
Pricing (Opportunity Type 1)	7	2	0.24
Pricing (Opportunity Type 2)	11	2	0.18
Pricing (Opportunity Type 3)	15	3	0.10
Opportunity Owner Review	0	0	0
Obtain Customer Acceptance	0	0	0
Record Win & Update Contract	0	0	0
Product Review	5	1	0.1
Initiate Fulfillment Activation	0	0	0
Fulfillment	4	1	0.03
Inform Customer	0	0	0

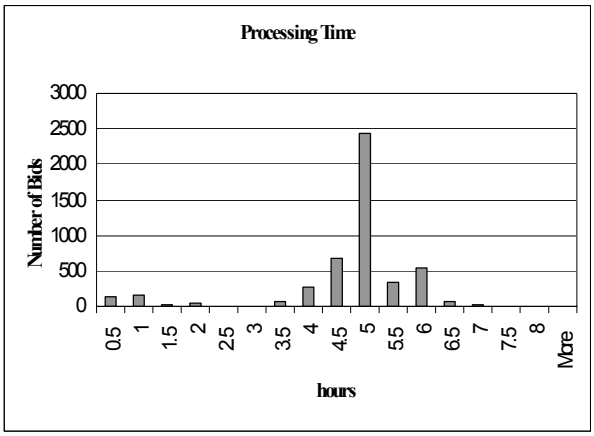

Figure 2. Simulation Results: Histogram of Overall Processing Time

For the particular scenario mentioned above, in processing about 5,000 bid opportunities, the overall processing time distribution is shown in the Figure 2. The processing time here is the overall response time to customer, and it includes the queuing time. The simulation results indicate that the mean of overall processing time for the proposed process is about 4.5 hours while the processing time for the current opportunity management process is significantly

longer. Therefore a substantial improvement can be achieved by the process change. The simulation study also shows that the processing time is affected heavily by customer response, e.g., about a half of the 4.5 hours of processing time is contributed by customers responding to the proposed bids, not by the IBM internal process.

The simulation also allowed us to estimate costs for each task and each resource. Table 2 shows average processing time based on about 5,000 bids. Using unit cost data of resources involved in each task we can estimate the total cost of each task and for each resource. The level of utilization for each resource can also be estimated from the simulation study. Table 3 shows the percentage utilization for each resource, e.g., marketing rep, product manager and pricers. From the simulation study, we were able to identify opportunities for potential cost reduction in some resources and service improvement in other resources.

Table 2. Simulation Result: Processing Time

Name	**Processing Time (hours)**
Enter Opportunity	0.17
Feasibility Assessment	0.03
Pricing (Opportunity Type 1)	1.58
Pricing (Opportunity Type 2)	0.37
Pricing (Opportunity Type 3)	0.57
Opportunity Owner Review	0.17
Obtain Customer Acceptance	3.00
Record Win	0.17
Product Review	0.29
Initiate Fulfillment Activation	0.17
Fulfillment	0.33
Inform Customer	0.17

Table 3. Simulation Results: Resource Utilization

Name	**Utilization (%)**
Marketing Rep	16.73
Brand Manager	7.72
Fulfillment Manager	53.35
Pricer (Type 1)	73.21
Pricer (Type 2)	65.32
Pricer (Type 3)	69.39
Product Manager	47.01

5. Conclusion

We have modeled an opportunity management process of an IBM Business Division using a new business process modeling methodology called Operations Specification (OpS). We described how the business process was modeled using three components: Information, Function and Flow. The simulation study indicated that a substantial improvement, especially in the processing time, can be achieved by process changes and proper allocation of resources. The overall processing time can be reduced to several hours, significantly improving the competitive advantage of the business. In the near future these simulation results will be used to guide process changes in the business.

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