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OBJECT-ORIENTED APPROACH TO INTEGRATING BUSINESS CONTEXT WITH BUSINESS PROCESSES

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Abstract

Successful change from a brick-and-mortar firm to a click-and-mortar organization depends on simultaneous analysis and change in all its major elements. The human element is a major element and yet neglected by organisational change methodologies. Especially the 'Context' comprising of deeply imbedded business models and mindsets are not captured by process methodologies of transformational change. The research question is 'How can most of the information related to the context of the business processes, mainly the human context, be systematically captured and integrated with the business processes?'

To answer the question, the researcher developed an Object Oriented [OO] approach to organisational understanding, based on Richard Watson's (2000) work on strategy for Internet organizations. The approach captures not only the processes, but also the attitudes, mindsets, behavioral patterns of people running the processes, as well as their surrounding context. The interplay between them is captured through 'causal patterns' that are often at the root of organisational success or failure. Causal patterns are sustained patterns of behavior in an organisation, formed when behavioral patterns interact with each other. The OO approach adduced effectively captures, models and analyzes the phenomenon.

The OO approach was validated by applying it to an organisation. Case study research methodology was used. Research results indicate that 5 years back causal patterns had led to good market reputation with good loyalty of customers, suppliers as well as employees. Over time, though the business processes remained unchanged, the context changed, turning virtuous causal patterns into vicious. Reengineering would have failed, as the problem did not have roots in business processes. Whereas OO approach neatly captured the phenomenon.

The research implies 1) revision in change methodologies 2) OO can be used to model Internet organizations-their strategies and their internal operations together, increasing the probability of successful eBusiness transition 3) Realistic simulation of any organisation 4) It can give directions in identifying process granularity and help ERP implementation.

Keywords: Object oriented modeling, business process, causal pattern, context, human behavior.

Introduction

With rapid transition to Internet, organizations are faced with transformational e-business change (Hammer 2001). Successful organizational change depends on simultaneous analysis and change in of all the major organisational elements. Human issues and human context are extremely important for successful organisational change, as suggested by the study of problem areas in reengineering implementations (Clemons, et al 1995). However reengineering methodologies fail to capture business context (Oram, et al 1997). Especially the 'Context' comprising of deeply imbedded business models and mindsets, is not captured by process-oriented methodologies of transformational change. Context plays a vital role in organisational success (Wentz 2000), especially for e-businesses facing rapid change in operations and collaborations. This important lacuna is sought to be corrected through an OO approach.

Literature Review

Reengineering questions the entire existing operation and tries to redesign it in a way that uses new technology to serve customers better (Jacobson 1995). It originated with process and IT-centered view of change (Hammer 1990, Davenport and Short 1990). Simulation and analysis aided selection of best 'process + IT' alternative. Some integrated reengineering with strategy planning, making it evolve from strategy and making it a routine activity. Others used creative methods to reengineer processes. The methodologies have a major lacuna of not considering human context:

The process approach “analyses and designs workflow and processes within and between organizations” (Davenport and Short 1990). Methodologies are given by Ould (1995) and many others. Process analysis methodologies and software like ARIS, STRIM/RAD, Action, SOM and IDEF among others were looked at. It is clear that “The role of people is seen [*only*] as performing steps in the procedures...Primary focus is minimizing cycle times and cost.” Scherr (1993).

Hammer (1990) proposed to “use information technology to radically redesign business processes to achieve dramatic performance improvements”. Process opportunities are summarized by Earl and Khan (1994). Methodologies are proposed by Davenport (1993) among others. IT implemented by many firms (Ascari et al 1995) demonstrates its impact.

Simulation and mathematical analysis lead to better decisions in changing business processes in case of multiple possible alternatives (Ackere et al 1993; Van der Aalst 2001). Its importance is seen in 'Beer game' (Ackere et al 1993) and its implementation in Pacific Bell (Housel et al 1993). Reengineering was linked to strategic objectives and used routinely to implement them (Earl et al 1995). This is done through benchmarking or continuous learning.

Business processes can also be reengineered through creative techniques shaped around human behavior (Cooper and Markus 1995). Among all, only these reengineering approaches may consider human context. However they do not offer a framework to capture or integrate human context with business processes.

These approaches advise consideration of human context but offer little guidance for systematic analysis. A comparison of process analysis tools and methodologies (Hess and Oesterle 1996) shows up this lacuna. Study of problem areas in reengineering implementation stress the lack of focus on human context (Clemons, et al 1995). “*Content* is the focus of re-engineering... [where] content includes [elements] that dictate how processes function. *Context* on the other hand, comprises the deeply imbedded business models and mindsets that drive organizations...and changes in context must precede any change in content” for any transformation change to occur (Wentz 2000, pg 27).

“Context is everything...” and is the key factor for performance increase and success (Gaboury 1999). The importance of context and subcultures for business success and failure is widely acknowledged and discussed by researchers like Rueylin (2001), Cooke and Rousseau (1988), Handy (1985), Rice (1963), Likert (1961) among many others.

Although recognized in literature, in practice it was found that a great amount of textual data on attitudes, drives, mindsets and environmental factors, is difficult if not impossible to represent or analyze. This limits discussion and sharing of information on this critical aspect. How to depict the interacting subcultures that lead to business activities as well as lead to cause maps leading to the root of the problem? A greater context representation is required to understand the root cause. Instead of coming across by chance, a systematic method is required to predict it by collecting certain data.

Research Motivation

The research gap was vividly seen in the reengineering of business processes of Thermax Ltd conducted earlier by the researcher. Thermax faced acute problems of accounts receivables [AR] i.e.. money owed by customer to the organization, affecting its bottom-line. The finance department was responsible for payments to suppliers of raw material. Execution department ensured shipment of finished goods to customer. Recovery of payments from customers was the responsibility of the finance department.

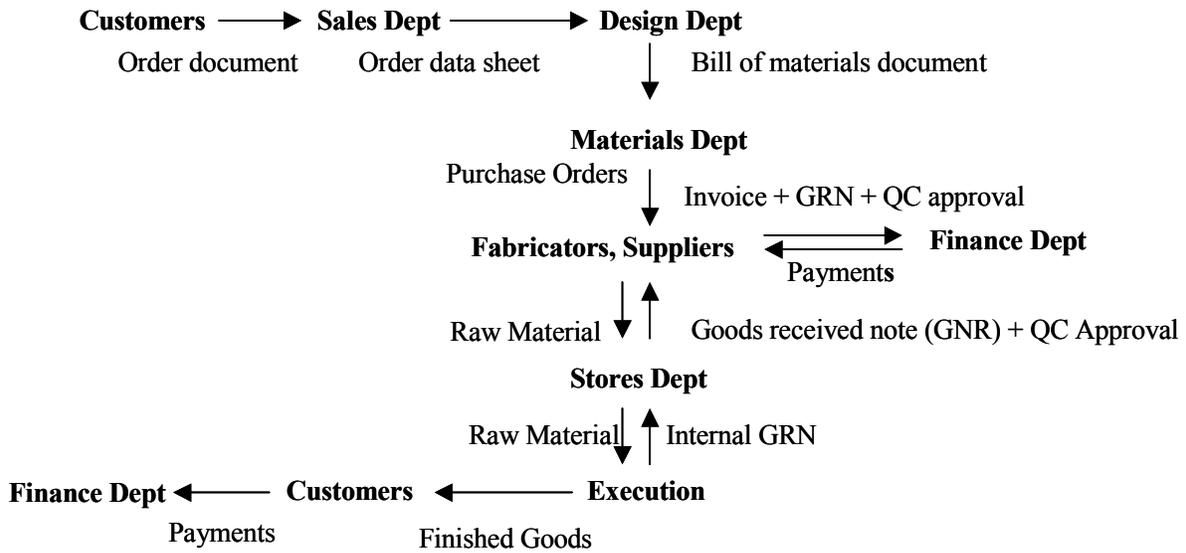


Figure 1. Thermax Ltd. Business Process

The Accounts receivables problem went undetected by process approaches. Deeper analysis revealed each department having a set of behavioral pattern. Interaction between behavioral patterns generated sustained causal patterns:

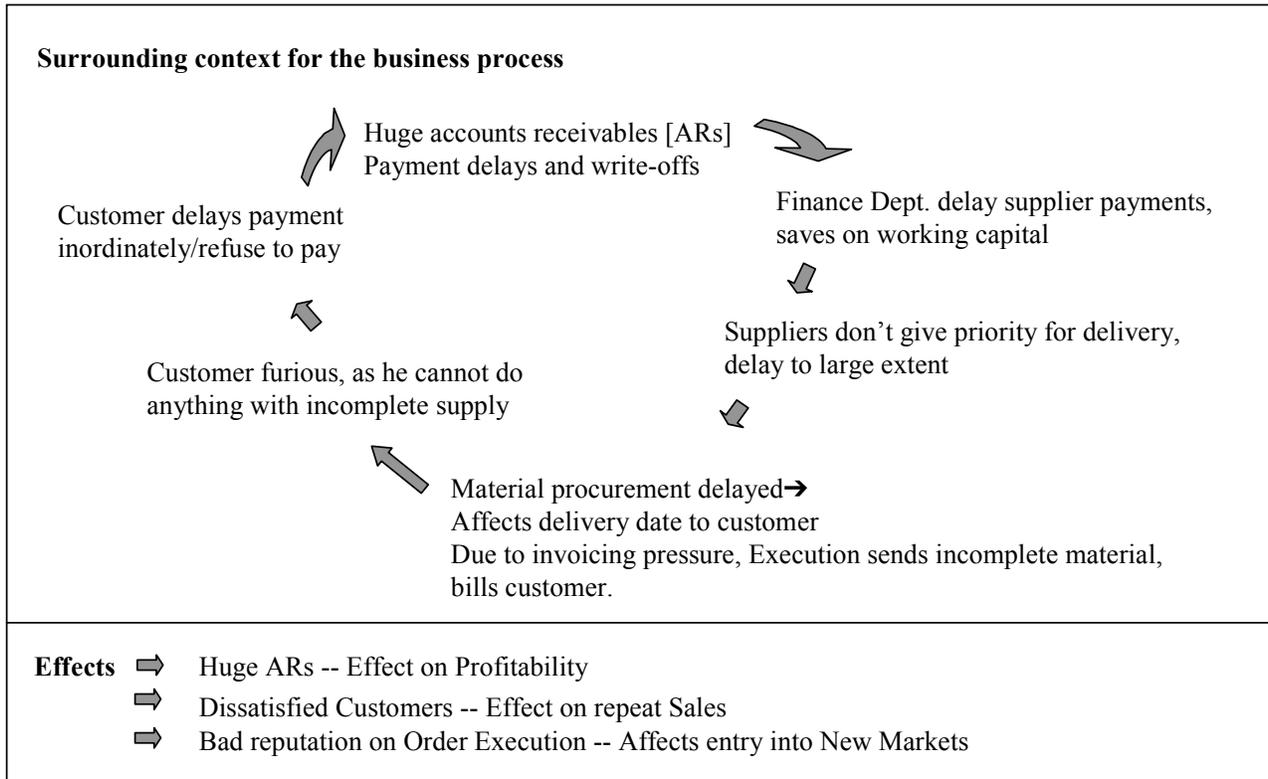


Figure 2. Causal Pattern

Research Question

How can most of the information related to the *context* of the business processes, mainly the human context, be systematically captured and integrated with the business processes?

An OO approach was developed to answer it. The rest of the research verifies it, applying it to an organisation.

Object-Oriented Approach

"The objective of OO design is to identify accurately the principle roles in organization or process, assign responsibilities to each role, and define circumstances under which roles interact with one another. Each role is encapsulated in form of object. This approach is different from more traditional analysis methods, whose emphasis is on process role oriented model is concerned with the policies or conditions that constrain task performance." [Pancake 1995, pg 34].

This summarizes the new OO approach.

The Organisational Object

Watson (2000) proposed OO to understand inter-firm issues where each firm takes up a certain role to acquire and execution a customer order. This is adapted to understand intra-firm issues, where groups of employees inside a firm take on different roles to execute the order [Figure 3]. The interpretation of 'know how and 'know why layers are different from that of Watson, and so are the object properties and characteristics [Table 1].

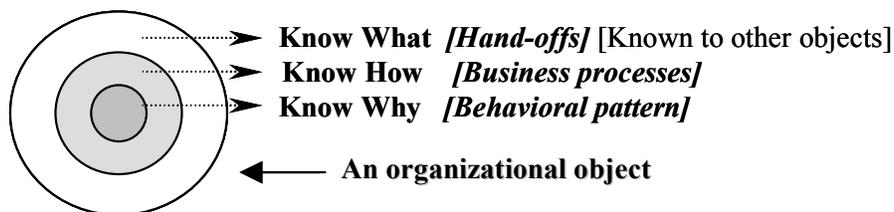


Figure 3. Organizational Object with Layers of Encapsulation

Hand-offs/now what layer:

Essentially the knowledge about what an object can do and how others trigger it to get services its responsibilities, services, input requirements from others and its outputs. The information inputs are simple levers for other entities to get outputs/ services.

Business processes or now how layer:

'Know how' is about the object's business processes, the data and methods, e.g. process of equipment designing; scheduling/prioritizing activities and requests. Inputs at 'know what are processed by the object in its now how layer, converting it into "outputs". The complex internal activities are hidden by the object from others, saving time and efforts for others to interact. Process change approaches deal at this layer and above, optimizing information linkages/ hand-offs and rationalizing process and individual process parts within objects.

Behavioral pattern or now why layer:

Behavioral pattern explains why objects process requests the way they do. It explains the object's mindsets, values, beliefs and other conscious and subconscious properties evolving over a period of time. These are embedded deep into an object and form the core of the object. It is the root of many an operational issue. Example, 'Engineering design object in a firm may get all the required order details from 'Sales and yet fail to process the request on time. If the problem is not in lack of resources, process bottlenecks, operator overload or some such process difficulties, then the earlier two layers fail to explain the situation. The problem could be in Design perceiving Sales as an unimportant entity and thus treating its requests as unimportant [mindsets]. Or it may perceive the order as technically uninteresting/ unimportant [drive]. Or it may simply be to get more respect and

attention, as it feels neglected [drive to promote self-interest]. Many such situations exist in organizations that cannot be captured through processes mapping. The process of generation of 'know why' shows the extent and ability of the OO approach to capture high amount of organizational complexity.

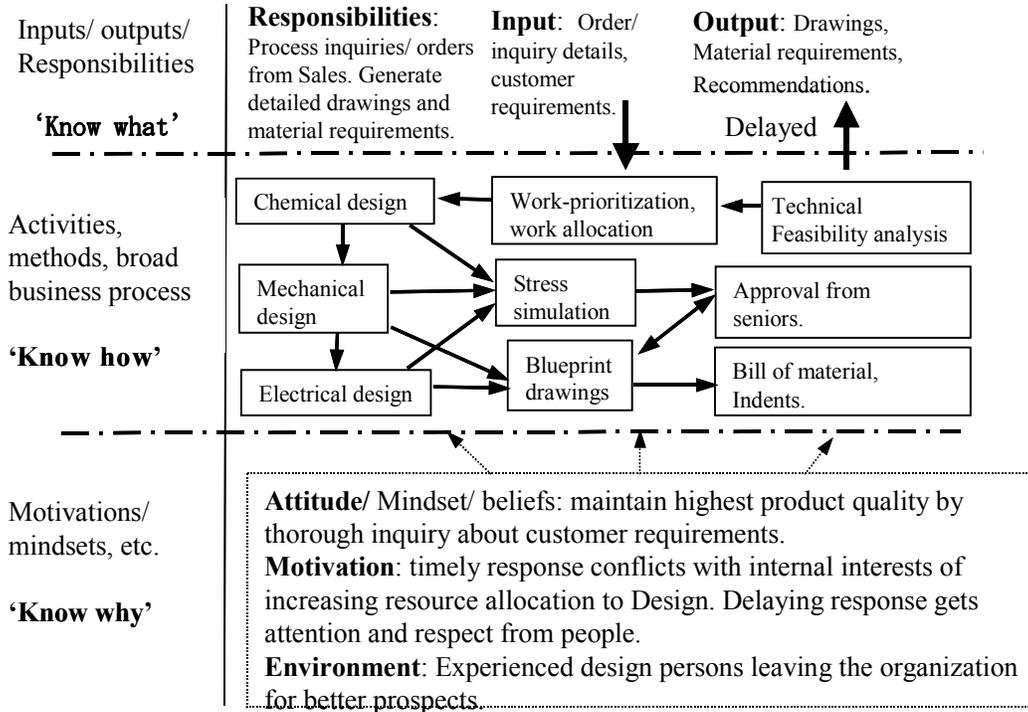


Figure 4. Design Function Encapsulation Layers Unraveled-- an Example.

Table 1 summarizes the application of OO concepts. Other OO concepts applied to organizational context but of lesser importance are:

- 1. Object class
- 2. Aggregation
- 3. Reuse
- 4. Polymorphism
- 5. Inheritance generalization/ specialization
- 6. Friend object

Organizational Objects and Organizational Subcultures, Causal Patterns

The most common subcultures are those based on function (Caldron, 1992), as managers in different functional areas, like sales, production, research and development, personnel management and training, tend to exhibit systematically different personal orientations (Cooke and Rousseau, 1983). The subculture is seen in terms of orientation of the objects-- Sales department tends to be externally oriented, with emphasis on rapid customer responses, while Production is internally focused, emphasizing technical efficiency and cost. These are their subcultures (Cooke and Rousseau, 1988). Handy (1985) suggests organizations are best served if different functions have different cultures to build deep functional strengths that can be defined and established through managerial action. "After all, who doesn't want accounting department to be cost-conscious, or researchers to be innovative?" [and not the reverse]...although this produces conflicts of interest. The orientations are systematically captured by the object layers. Hence organizational objects possess their own subcultures.

Table 1. OO Approach Adduced [with support from Watson (2000), Wand and Woo (1999)]

Concept	Computer science	Watson's Application Strategy [Inter-firm interactions]	Intra-firm interactions
Object class	A group of objects with similar properties.	A group of firms with similar properties [an industry].	A group of organizational objects with similar properties, but in different divisions/ firms.
Object	A program containing data and methods.	A firm with an organizational memory and business rules.	An organizational 'role', with responsibility for particular services and processes. Different objects have identifiably different layers of encapsulation. However the basic difference needs to be at the 'know why' layer.
Message	Objects request services from each other by exchanging messages.	Firms request services from each other by exchanging messages.	Organizational objects request services from each other by exchanging messages.
Encapsulation	All processing that changes the state of an object is done within that object.	A firm is an autonomous unit, but there are situations where de-encapsulation is beneficial.	Business processes parts and human aspects are encapsulated.
Reuse	A new application can be built from existing objects.	A new firm can be built from existing firms.	A new composite object [the firm] can be built from the blueprint of existing objects.
	Code must be written to exchange messages between objects.	Procedures must be developed for exchanging messages between firms.	Procedures must be developed for exchanging messages between departments.
Generalization/ specialization hierarchy	Object classes can be specialization or generalizations of other classes.	A multi-divisional corporation.	Example, the Human resources departments in each division of as multi-divisional organization is specialization of a central corporate Human resources.
Inheritance	Classes inherit properties from their super-class.	Divisions inherit properties from their corporation.	Departments inheriting properties from their central corporate definition.
	Inherited properties can be reused or overridden.	Inherited properties can be reused or overridden.	Inherited properties are reused or overridden.
	Inheritance eliminates redundant data and methods.	Inheritance eliminates redundant data and methods.	Inheritance eliminates redundant processes.
Attribute - Joint state variable	A shared state variable changed by others, making the object unstable.	Not specified.	An interface information known to others who require service from an object. Example 'order details' are required by the design dept. If complete information is provided, the object is under obligation to provide service.
- Internal state variable	The variable used by the object for internal manipulations/ operations to arrive at output.		The internal variables that the object [department] manipulates to provide requested service. Example, leave plan of its members, availability and distribution of scarce internal resources, etc.

Subcultures often tend to conflict with each other, leading to causal patterns. Likert (1961, pg. 108,109) mentions how Sales department forced other departments like production to decrease costs, thereby imposing excessive difficulties on them. Each tried to enlarge their area of responsibility, encroaching on other's territory leading to 'mutual recriminating circular process'. Recently causal patterns of high complexity were found by Rueylin (2001) explaining failure of IT in a firm. The dynamics were linked to chains of inter-linking causes rooted deep inside the subculture of interacting departments. Interacting organizational objects capture such causal patterns.

Field Research Objectives [RO]

To systematically verify the OO approach, the researcher planned to

1. Seek organizational units that could be viewed as objects,
2. Understand and model their characteristics into objects: know what, know how and know why layers.
3. Model their formal interactions as business processes
4. Model their informal interactions in terms of causal patterns
5. Integrate the causal patterns with business processes

Research Method

Case study research methodology was most found to be suitable as it addresses questions related to 'why' and 'how' while focusing on contemporary events (Yin 1984). It allows an investigation to "retain the holistic and meaningful characteristics of real-life events, such as organisational and managerial processes" (Yin 1984). Specific case requirements were constructed on the basis of certain derived criteria. The case had to be amenable to analysis, with the required elements prominent enough to enable strong observations, thereby helping establish the research objectives as firmly as possible. Function-based organization was preferred compared to team-based. Avasarala Automation Ltd. [AA] satisfied the case requirements. It was selected among other organisations because an earlier study of AA by others indicated that AA might have operational problems that cannot be captured by processes mapping.

To gather data, field questions were formulated that people in AA can relate to and answer. These were derived from 'operational events to be studied' constructed from the 'research focus'. Taped in-depth field interviews were conducted with 25 decision-makers, mainly engineers, managers and top management. It excluded draftsmen, clerical staff and shop floor workers.

Qualitative Data Analysis Categorization, Index Development and Data Coding

N.D.*IST [Non-numeric, Unstructured, Data Indexing, Searching and Theorizing] software was used. Quality was ensured through Construct validity, Internal validity, External validity and Reliability tests.

Data preparation included transcription and preparing it for N.D.*IST. The data was segregated using a coding schema created to provide/remove support to the OO approach. Two sets of nodes were created. First set addressed the first three research objectives, and represented organizational objects. Second set representing causes and effects, modeled the object informal interactions giving rise to causal patterns. Sample of nodes:

Level 1: Causal patterns
 Level 2: Supplier payment delayed
 Supplier delays material
 Short supply to customer
 :
 :
 :

The coding schema reflects the fundamental findings in this type of study. A statistic pulled from N.D.*IST database to quantify the qualitative data is usually misleading. If quantitative analysis was the aim it would have been better to have started with numbers in the first place and saved a lot of time (Miles and Huberman, 1984). Effort was made to create an indexing schema resulting in greatest possible understanding of findings. And a robust Research analysis process was built as given below. It processed the N.D.*IST information to arrive at "Research Results."

Research Analysis Process

The first RO was to “seek organisational units that can be viewed as objects”. The whole firm can be viewed as object (Watson, 2000), or a department, or, a group of people within a department/ organization, or, every single individual. After analysis, groups with similar drives, similar responsibilities leading to similar inputs, outputs and activities, were considered as objects. Basic concurrence was at now why layer.

The second RO was to ‘describe objects in terms of layers of encapsulation’. The N.D.*IST information was understood from OO perspective and summarized through an ‘object definition template created specifically to describe organizational objects.

The third RO had to model the formal object interactions as business processes. UML [Unified Modeling Language] constructs swim lanes to depict software object interactions and workflow. This is modified to accommodate organizational object layers and then used to depict business activities.

The fourth RO looks at the business context through informal interactions between objects seen as causal patterns. The object definition template allows depiction of now why layer, and also the causal links that connect objects to each other. These links then bind together to form causal patterns.

The last step was the fifth RO of integrating the business processes with the causal patterns. The business processes and the causal patterns understood separately till now as part of the organizational objects, had to be unified. The concept of organizational objects conceptually unifies business processes with causal patterns by becoming the common point of origin. The Swim-lane concept is further extended to accommodate the depiction of causal patterns as well as business processes.

Research Results

AA manufactures material conveyor systems and Special Purpose Process Machines [SPPMs], employing 150 people, mostly shop floor workers. Material conveyor systems move refrigerators, cement, sugar, fish, etc in a plant. It is customized and customer involvement is high. Special Purpose Process Machines-- SPPMs are for special processing of material, like acid baths, made for specific customer requirements. AA faced problems of profitability and customer retention. It also faced problems of chronic delays in delivery, account receivables, supplier non-cooperation and many others. These problems affected the bottom-line.

Each employee was initially considered as single object. Employees with similar drives and motivations were grouped into one object. Each object was described through object definition templates [Table 2].

Organizational objects [Objects considered part of the system]	External objects [Objects that are not a part of the system].
1. Sales	14. Customer
2. Application	15. Supplier
3. Design	
4. Project planning and control [PPC]	
5. Vendor development	
6. Manufacturing	
7. Purchase	
8. Stores	
9. Assembly	
10. QA	
11. Finance	
12. Dispatch	
13. Top Management	

Table 2. Sales Object of AA

Object Name: Sales

Know what layer			Know how Layer	Know why Layer	Causal links
Responsibility	Inputs	Outputs			
<ul style="list-style-type: none"> • Get orders • Customer communication — One point contact. • Realise payments 	<ul style="list-style-type: none"> • Market data on potential customers • Visit customer to collect data • Customer enquiry data. • (Customer not ready to commit to details) • Discuss feasibility with design • Finalisation discussions with customer • Kick-off meetings get clarifications required • Drawing approvals from customers • Payments 	<ul style="list-style-type: none"> • Brochures to potential clients. • Solicit enquiry • Forward enquiry to design, discuss feasibility • Give offer documents to customers • Follow-up for orders • Finalisation discussions with customer • Send work-order to all depts through PPC • Kick-off meeting— Disseminate information. • Give ‘hand-over’ note to all departments through PPC • Communicate with customers to get approvals • Communicate with customers to get payments • Product proposal to client (Proposal not clear on many points) 	<ul style="list-style-type: none"> • Analyse market data to shortlist potential customers • Understand and note customer requirements • Do costing • Prepare Technical offer • Decision on pricing discounts and terms • Make commercial offer • Prepare work-order • Prepare hand-over note <p>Prepare technical and commercial proposal for customer. (Sales not educated on all aspects of proposal making, don't have all data)</p>	<p>Drives: ‘ Order booking’ targets —meet or exceed</p> <p>Perceptions, Environment: Market needs new products, product range insufficient Clients need: turnkey solutions, one-stop shop Clients dictate terms and we need to follow</p> <p>Product quality is good. Design not ready to take risks. Design needs to cut equipment costs Same products for 15 yrs since inception. No change. Need product range as “our products are not much better than our competitor’s”. Loose orders as do not have product range. “It has been agreed that there will be no partial dispatches, but...” Design takes up more time than planned or us customer is a relationship. “For other departments it is a one-time project.” “They feel the customer should be vendor oriented. Still in the old mindsets.” “99.99% projects delayed. Our ‘One-stop shop’: Customer stops only once, never to come back.” Problems with Purchase, supplier payments</p> <p>Attitudes: Outgoing, Neatly dressed, Don like desk job. Customer oriented: Understands customers better than s/he understands HO.</p>	<p>Linking ‘know why’ or, the inputs to the characteristics of their output.</p> <p>Order booking targets lead to Sales giving less stress on order quality, leading to process problems, especially Design object suffering from lack of information.</p>

These were named according to their responsibilities. Few of them were pre-defined departments, like ‘Design’. Others like ‘application’, which formed a part of the Sales department, were not identified by AA as departments and could be discerned only through the OO lens. The swim lanes depiction of business processes efficiently depicted the interaction of organizational objects at their now what and now how layers

The central part of the research results was the causal patterns, capturing the context. Five years back AA had minimum three sustained causal patterns bringing good market reputation, customer and supplier loyalty, and employee loyalty. Over the years each virtuous causal patterns turned into vicious ones, merely with change in external market context. One such causal pattern is depicted below.

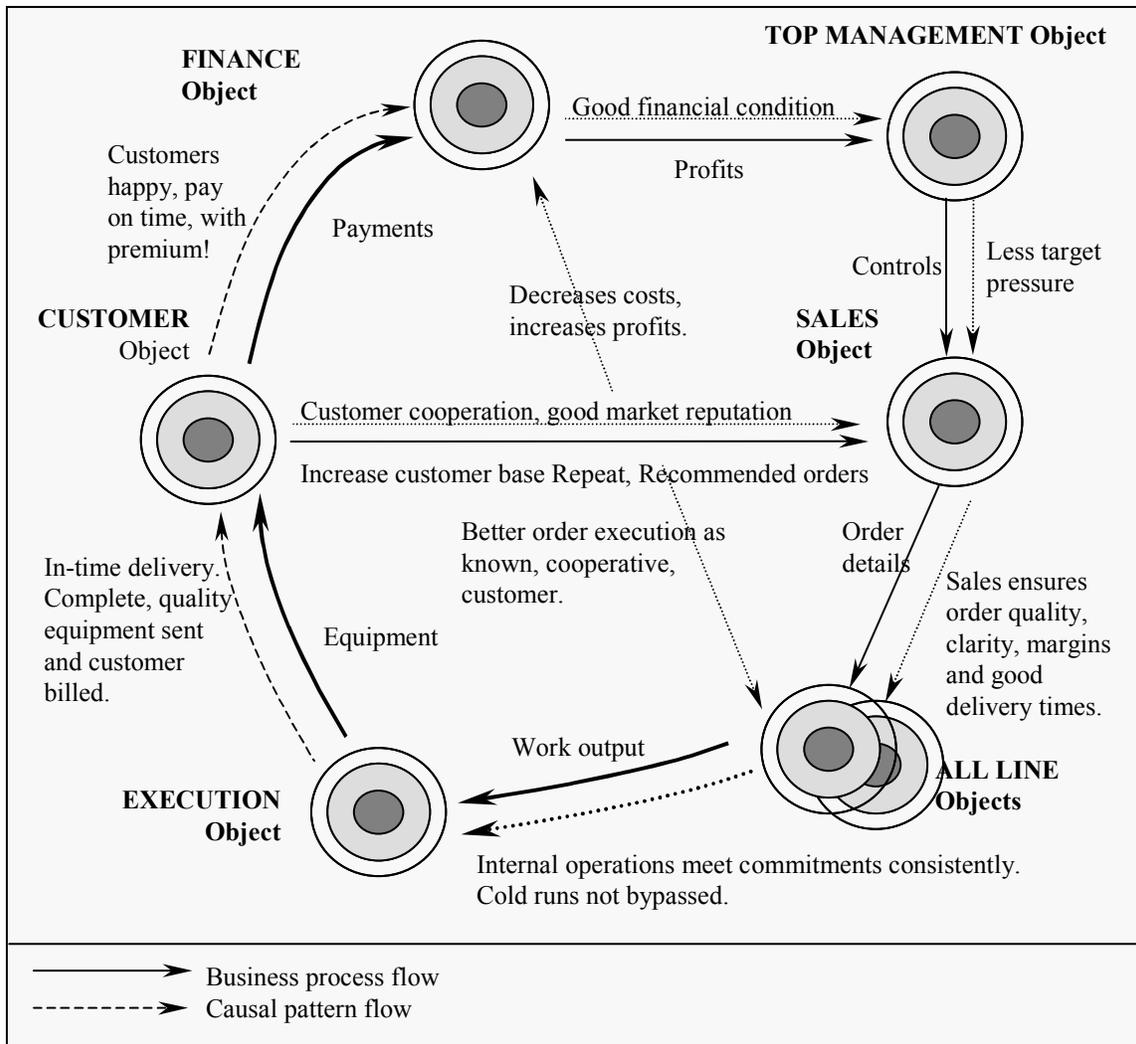


Figure 5. Virtuous Causal Pattern in AA

Prior to 1996, the market was booming. Sales had more customers and orders that they required. This allowed them to focus on order quality and negotiate better deals. Order clarity and proper delivery schedules allowed AA to meet commitments. As most of the customers were repeat customers, their requirements were known and communication channels established, allowing smooth collaborations and increasing profitability. While repeat customers offered premium for staying with AA!

CONTEXT CHANGE:

In mid 1990s, liberalization policies in India lead to growth of market demand. AA market reputation made it easy to get new orders. AA decided to increase scale of operations, recruiting new employees rapidly. The organization became too big and

unwieldy for the management used to small, known, close-knit group of people. The virtuous pattern broke in 1996 end when industry recession set in, dramatically shrinking market size, leaving too many sellers and too few buyers, who were strapped for funds. Margins decreased and so did order size and volume. More efforts and overheads were required to acquire and execute orders.

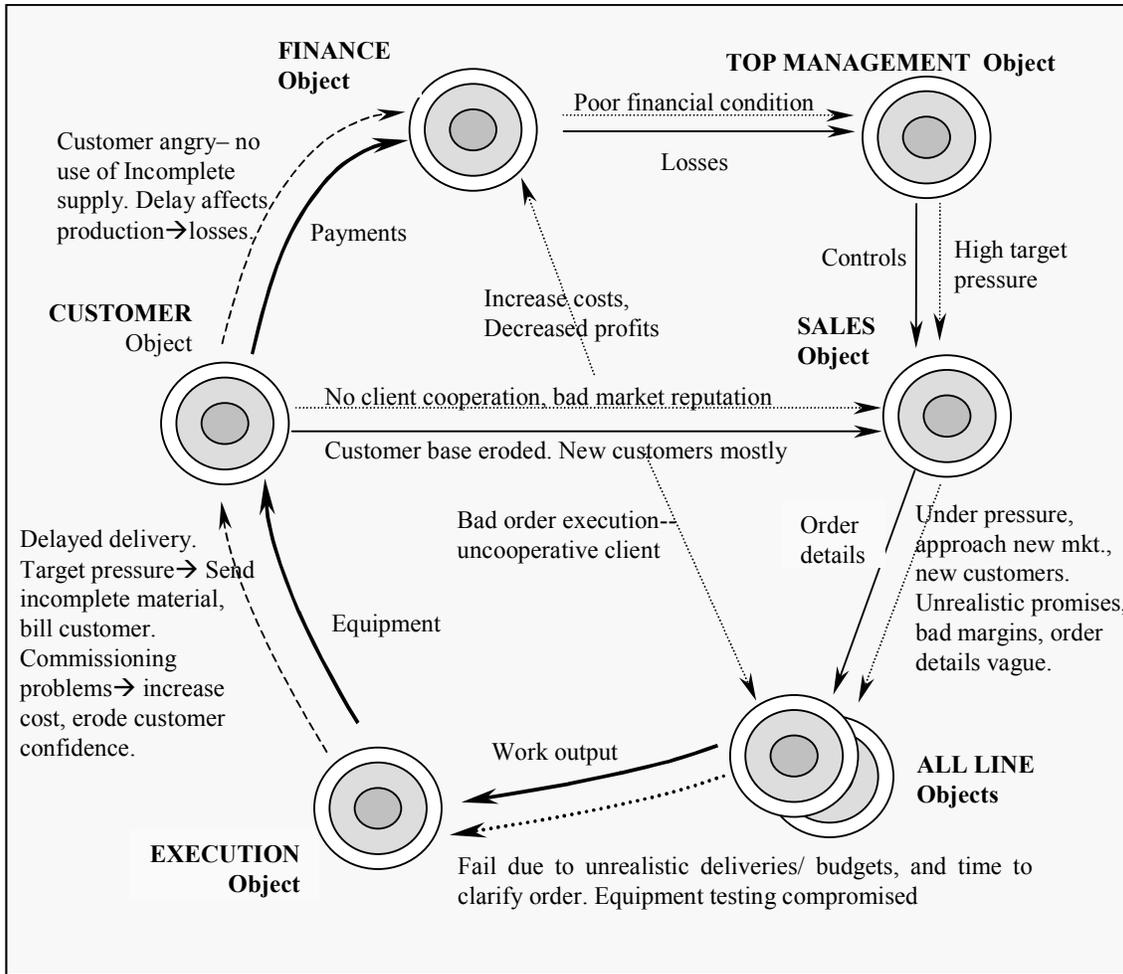


Figure 6. A Vicious Causal Pattern in AA

The company slogan was ne-stop-shop where customers shop for all their needs. Sales viewed it as ne stop shop-- customer does not come back again! It has literally become that. It is supposed to mean something else but now it means this to me. As AA did not change its processes over the years, this critical aspect was completely missed out in purely process view of AA. Whereas the OO approach perfectly captured the phenomenon. After all the OO approach originated in the desire to capture such phenomena observed in Thermax Ltd. Observations in AA firmly established existence of causal patterns that capture the crucial part of business context and showed it could be captured only by the OO approach. Causal patterns were established as separate and distinct from business processes. And yet it was observed that business processes and causal patterns influenced each other deeply and had to be considered together, which is inline with observation by other researchers (Wentz 2000). The object representation of organizational working conceptually integrated business processes with causal patterns, and the swimlane concept integrated them in depiction. This addressed the last research objective.

Research Contributions and Limitations

Contributions

The most important contribution is to demonstrate how the two fields of organizational behavior and information systems can gain from each other. Organizational behavior consists of systems that are highly complex, one of the most intelligent and having extremely high variables. Whereas information systems consist of one of the most systematic and structured concepts for building and analyzing complex information systems. A symbiosis will lead to systematic analysis of organizations and human societies. It may also lead to the generation of advanced tools and concepts in information system that enable development of extremely complex information systems, example extending the Rational tool to integrate IT and business systems.

1. Model Internet based organizations: According to Hammer (2001), the revolutionary impact of the Internet will be in dissolving boundaries between companies. Just as businesses reengineered internal processes to reduce inventory, overhead and cycle times, they will now reengineer externally by combining certain processes across enterprises to gain even bigger benefits. This is the virtual integration between organizations on non-core competence areas, like transportation of their goods, financial accounting, etc. It is seen in procurement marketplaces like *ovisint* owned by General Motors, Ford, DaimlerChrysler AG, Nissan, Renault and Peugeot-Citroen. However the Sales/ Marketing functions and the Purchase function have very different orientations/ subcultures. These two belonging to different organisations have to interact with each other in real-time rapid collaborations, can lead to as rapid a failure if the surrounding context [causal patterns] is not considered and integrated.

Examples like *Covisint* now abound, as they reengineer processes externally and internally. Such an organizational change can be easily modeled by simultaneously using the adduced OO approach that looks internally, with the approach by Dr. Watson (2000). Real-time collaborations can now be visualized and analyzed using objects. The approach models most of the root causes of the critical organizational problem areas. Hence with OO, it should be possible to dramatically bring down the failure rate of internally reengineering processes and externally reengineering the collaborations.

2. Revision in change methodologies: Change methodologies may now be modified to include 'business context'.

Organizational complexity to a large extent can be captured, understood and analyzed methodically: This reduces dependence on those having deep experience and judgment of human behavior. It implies possibility of creating now why layers to use human potential effectively while increasing business success.

3. Comprehensive simulation of organisations: Causal patterns may be constructed/ predicted [new firm]/ detected [existing firm], to influence 'virtuous' and detract 'vicious' ones.

4. Improved change efforts due to coupled IT and business systems: Organisational objects in one model can correspond to software objects in the other, giving a clear picture of the goals that business systems and information systems would meet together.

5. Modeling human societies with OO: Wherever there is division of labor or difference in work and these groups have to interact, they can be represented using OO.

6. Process granularity for process change: As reengineering is usually conducted before implementing ERP, it assumes serious proportions. Process identification is easy with OO— process boundary is either an organisational object [for process changes], or, originating link/ weakest link in causal pattern one attempts to break.

Limitations

1. The OO approach fails to reflect full organisational reality:

- Context elements like opportunity, goal setting and constraints (Mowday and Sutton 1993) are captured by OO approach, but 'powerful leaders' is not.
- Representation of Supplier or Customer roles, when each customer/supplier has vastly different profiles, is not effectively addressed.

2. The above application represents only a part of what is possible in the vast field of OO.

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