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## Enterprise Modeling and Simulation Applications in Reengineering

Process reengineering as defined by Hammer and Champy in their book, *Reengineering the Corporation*,<sup>1</sup> is "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed." It is being applied at an increasing rate by three kinds of companies: those in deep trouble, those not yet in trouble but whose management has the foresight to see trouble coming, and those in peak condition with no discernible difficulties whose management is ambitious and aggressive. These three categories cover a large number of companies. The impact is on processes with throughputs measured in the billions of dollars.

Reengineering is pervasive, controversial, and disruptive, and has different interpretations. CSC Index, whose chairman is Champy,<sup>1</sup> states that even though they pioneered the practice of reengineering, they are startled by how widespread the phenomenon has become. Their survey results<sup>2</sup> based on 497 large companies in the U.S.A. and another 124 in Europe show that 69% of the U.S. companies and 75% of European companies are already reengineering (average completed or active initiatives in excess of 3). More than half of the rest were planning to launch an initiative over the next 12 months or were discussing one.

Hammer and Champy<sup>3</sup> mention three kinds of techniques that reengineering teams can use to help them get ideas flowing: boldly apply one or more principles of reengineering, search out and destroy assumptions, and go looking for opportunities for the creative application of technology.

A sampling of the literature reveals that redesign is influenced by the past experience of the reengineering team and the recommendations of reengineering consultants. Ultimately, many redesign decisions are made on speculation based on implicit mental models, convincing arguments by vocal proponents for change, sheer optimism, blind faith, or desperation.

A major concern is the uncertainty of predicting outcomes. Radical redesign and new ideas bring the possibility of boundless gain or tremendous loss. While assumptions are being searched out and destroyed ruthlessly, it should not be forgotten that some assumptions are rooted in scientific principles which cannot be ignored with impunity no matter how highly enthusiastic or motivated the reengineering team.

### Enterprise Modeling and Simulation

Some areas suggested by Hammer and Champy<sup>4</sup> for reengineering the corporation include product development from concept to prototype, sales from prospect to order, order fulfillment from order to payment, and service from inquiry to resolution.

The Simple Model described in the accompanying article is a start towards addressing order fulfillment. Modeling and simulating the other processes on the list require different kinds of knowledge acquisition. For example, product development requires

more knowledge about the R&D function, sales requires more knowledge about the marketing function, and service has not been considered in the current model, where the focus is on manufacturing.

The following paragraphs describe areas where enterprise modeling and simulation and the enterprise modeling and simulation system may provide value in the reengineering effort.

### Identifying Processes

Hammer and Champy<sup>5</sup> suggest that once processes are identified and mapped, deciding which ones require reengineering and the order in which they should be addressed is not a trivial part of the reengineering effort. Typically there are three criteria for making the selection: dysfunction, importance, and feasibility.

Enterprise modeling and simulation provide one way of gaining insight in these areas by generating performance metrics with and without the change under different circumstances. For example, the Simple Model showed the importance of different controllable and uncontrollable factors to the different system performance metrics such as EOL inventory and order-to-delivery cycle times.

After selecting a process for reengineering, an understanding of the current process is crucial. It is necessary to know what the existing process does, how well (or poorly) it performs, and the critical issues governing its performance from a high-level view. This understanding is the prerequisite to redesign. The key is understanding the process rather than completely analyzing it in agonizing detail.

Enterprise modeling and simulation offer at least two ways of obtaining this understanding and possibly showing the cause of the dysfunction. First, the very act of building a consensus model that different people can agree with sheds light on what might not be working. Second, simulating the model will confirm or reject the validity of what is suspected. For example, after building the Simple Model, it was possible to test it in a large number of possible operating conditions to provide understanding of the cause and effect relationships. The first major insight from simulating the model was that what appeared to be a reasonable way of computing safety stock that would go to zero as demand went down actually gave rise to end-of-life inventory even though the demand was forecasted accurately. Enterprise modeling and simulation provide a way of gauging the relative impact of different process changes as a step towards selecting the appropriate subprocess to reengineer, and of quantifying the amount of prospective improvement.

Enterprise modeling and simulation can show the prospective impact of infeasible changes. In simulating the proposed reengineering changes, even if they are infeasible, the results will indicate if there is any promise in further consideration of a particular direction. For example, it is clearly not feasible to have zero build

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time for products and zero transportation times for shipments in the real world, but setting those values to zero in the model indicates the theoretical maximum benefits of these actions, and the magnitude of the results provides a data point for decisions on how much investment to put on driving these two times to zero instead of on other opportunities.

Furthermore, by showing the time behavior of the changes, enterprise modeling and simulation can show when actions can be expected to take effect. Inertia is a property of most systems, reflected in the time taken to respond to external influences or changes. Most physical systems are predictable in this respect, but the time behavior for organizational systems such as the enterprise is less predictable simply because it is not understood as well. Enterprise modeling and simulation help to increase the predictability of system behavior given that we know something about the system's structure and the behavior of its components. While immediate improvement for reengineering is the desired goal, enterprise modeling and simulation can show the length and causes of delays in obtaining the desired result.

### Exposing and Challenging Assumptions

Hammer and Champy suggest that we question assumptions.<sup>6</sup> Enterprise modeling and simulation require assumptions to be stated explicitly during the model building process to reconcile differences in points of views. Challenges and disagreements on the validity are with respect to clearly stated assumptions rather than differences in opinions resulting from differences in mental models of different individuals. For example, the production planning and material procurement processes used in the Simple Model are expressed mathematically in Appendix I. If these are accepted as rational methods of planning, then there is no question or debate on the values of the outputs for a given set of inputs. If processes expressed mathematically are not acceptable as rational methods of planning and an alternative method is proposed, then that alternative method can certainly be tried, and the results compared with the previous method. The debate and challenge for improvement becomes one of improving the logic of planning rather than one revolving around the meaning of words and labels or one on how the model should behave based on past experience or speculation.

The approach advocated by Hammer and Champy suggests that changes be made by understanding the problem and devising the solution. This is central to modeling and simulation in addressing problems in the realm of the enterprise. Enterprise modeling and simulation offer a way of testing and verifying that given the current knowledge, the results of the simulation do not exhibit any obvious flaws before the process is implemented.

### Role of Technology

Hammer and Champy devote a whole chapter to discussing the essential enabling role of information technology, and assert that modern state-of-the-art information technology is part of any reengineering effort. They caution that the misuse of

technology can block reengineering altogether by reinforcing old ways of thinking and old behavior patterns, and that equating technology with automation does not result in reengineering.

We suggest that the application of enterprise modeling and simulation is a creative application of a well-understood technology to the processes of the enterprise. The technology of modeling and simulation has been applied to fields such as product design and the design of physical systems, but is only now beginning to be applied creatively in analyzing the processes of the enterprise. What enables the creative application of modeling and simulation is the tremendous increase in computational power. In this respect, we would like to suggest another rule along the lines of the rules described in reference 1.

*Old Rule:* Decisions regarding process changes are based on mental models and analysis of historical data.

*Disruptive Technology:* Enterprise modeling and simulation.

*New Rule:* Decisions regarding process changes are based both on historical data and analysis of computer simulated behavior of explicit models with explicit assumptions that show the prospective consequences of different actions under a large number of operating circumstances.

### Conclusion

Reengineering is a philosophy of renewal and rapid, discontinuous, and drastic change in the way corporate enterprises do their work, which brings with it uncertainty and fear of the unknown future. It is disruptive and controversial, and there is as yet no agreement that successes outnumber failures. During the implementation, "People focus on the pain of the present and the joy of the past. They forget about the pain of the past and the joy of the present."<sup>7</sup> However, given that it is occurring on such a wide scale, we suggest that application of enterprise modeling and simulation can increase the chances for success by (1) quantifying the potential benefits of the reengineered process in an explicit, defensible way, (2) illustrating the transition between the pain of the present and the joy of the future, and (3) showing the possible outcomes of current actions, thereby making the future more predictable and less surprising to those most affected by it.

### References

1. M. Hammer and J. Champy, *Reengineering the Corporation: A Manifesto for Business Revolution*, Harper-Collins Publishers, Inc., 1993.
2. *State of Re-Engineering Report, Executive Summary*, CSC Index, 1994.
3. M. Hammer and J. Champy, *op cit*, p. 146.
4. M. Hammer and J. Champy, *op cit*, p. 118.
5. M. Hammer and J. Champy, *op cit*, p. 122.
6. M. Hammer and J. Champy, *op cit*, p. 145.
7. J. Kornbluth, "The Prophet of Pain," *Worth*, Vol. 3, no. 6, July/August 1994, pp. 80-81.