

ABSTRACT # 007-0377

**THE CONVERGENCE OF FACTORY AND SERVICE
OPERATIONS**

**JOEL GOLDHAR (ILLINOIS INSTITUTE OF TECHNOLOGY,
GOLDHAR@STUART.IIT.EDU)**

DANIEL BERG (RENSSELAER POLYTECHNIC INSTITUTE, BERGD@RPI.EDU)

MEI XUE (BOSTON COLLEGE, XUEME@BC.EDU)

POMS 18th ANNUAL CONFERENCE

DALLAS, TEXAS USA

MAY 4 – 7, 2007

The traditional distinction between a ‘product’ and a ‘service’ has been the ability to use finished goods inventory to ‘decouple’ production operations/systems from the customer or user (including the channels of distribution). This allowed operations and marketing functions to operate independently; each optimizing its efforts around its own choice of internal metrics; but rarely focused strategically on the long-term sustainable profitability of the enterprise as a whole. In an age of human brain processing, physical collection and movement of data, and paper based archive information systems; this decoupling was the only possible response to the operating system’s need to organize around the ability to obtain, analyze and use information for coordination and control; in a timely manner.

The situation becomes more complex, however; when we consider that a service ‘product’ often integrates the product’s design, production and delivery; and when we recognize that many operating systems are hybrids of traditional factory and service operations. Therefore we must develop definitions that account for both the physical characteristics of the product/service and its production and delivery systems.

In today’s world of low cost, high speed, widely distributed computing power and nearly universal communications linkages; the traditional distinction is too simplistic: as are the organizational models developed to deal with the information needs of operations within the context of the limited capabilities of the ‘pre-digital’ information world. We need to develop a more sophisticated model of ‘operating systems’

for the design and management of 'production organizations' that deliver 'outcomes' that may range from the purely physical and durable to true 'services' that are consumed as produced (not to be confused with products that are consumed in use such as a cigar) and any possible combination in-between. Such a model will have to combine (and integrate!) the insights and tools of traditional Industrial Engineering and Operations Management with new tools and concepts from the Behavioral Sciences, Information Sciences and Engineering, Economics, and Industrial Design. The result will be a broader and more integrated strategic approach to creating customer value and sustaining competitive advantage. A 'model' where the 'Operating System' will include elements of all of the business functions and processes including Engineering and Design, Marketing, Human Resource Management, and Finance; within the context of Corporate and Business strategy.

This is not an especially new idea. For at least the past 3 decades, traditional manufacturing/products businesses have worked hard to be more service-like while the classic service businesses have made great efforts to gain some of the economic advantages of factory organization models. We also need to recognize that most, if not all, 'products' are purchased in anticipation of the 'services' they will provide to the user. In 1963 Professor Ted Levitt was saying 'Nobody wants a quarter inch drill – they want quarter inch holes'. Somewhat later, Quinn, Baruch and Paquette described 'products' as being purchased in the anticipation of the services they would provide ('Exploring the Manufacturing-Services Interface' SMR, Summer, 1988). Levitt also later developed the concept of the 'Augmented Product' that integrated physical and service attributes such as the

'made-to-fit' shoe or an extended warranty made possible by improvements in manufacturing quality control.

During the past 35 or so years the distinctions between products and services have become increasingly blurred. Services have continually sought to imitate the predictability and economies of scale of factory operations while traditional manufacturing firms have moved towards a service model with zero-inventory, make-to-order; EOQ = 1; just-in-time; mass-customization; and Economy of Scope based operations strategies: utilizing the software and hardware of CAD, CAM, FMS, Robotics, and CIM – all technologies made possible by the application of advances in digital electronics and Information Science to traditional manufacturing.

In 1972 Levitt wrote 'Production Line Approach to Service' (HBR, Sept-Oct, 1972) followed by 'The Industrialization of Service' (HBR, Sept-Oct, 1976). More recently Chopra and Laviviere published 'Using Service Inventory to Push Performance' (SMR, Fall '05) and Sampson and Froehle wrote 'Foundations and Implications of a Proposed Unified Services Theory' (Production and Operations Management, Summer '06) in which they offer a highly articulate description of the traditional service characteristics including heterogeneity, simultaneity, perishability, intangibility and 'in some cases' customer participation. This theoretical construct can be applied to a wide range of operating systems and outputs and helps take us beyond the traditional 'You can't stock a haircut'/ 4 Barbers – No Waiting distinction between products and services to a world where you can have a custom made shirt while you wait; but 'The Doctor Will See You for Exactly Seven Minutes' (Peter Salgo, New York Times, Op-Ed, 3/22/06).

On the other side of the manufacturing vs. services literature we have 'Plan for Economies of Scope' by Goldhar and Jelinek (HBR, Nov-Dec, 1983), 'The Service Factory' by Chase and Garvin (HBR, July-Aug, 1989) and 'Beyond Products: Service-Based Strategy' by Quinn, Dooley and Paquette (HBR, March-April, 1990); all essentially self-explanatory titles: as are 'Flexibility and Competitive Advantage: Manufacturing Becomes a Service Business' by Goldhar and Jelinek and Schlie (IJTM, 1991), 'Operations as Marketing: A Competitive Services Strategy' by Roth and van de Velde (JOM, Aug'91). 'Making Mass Customization Work' by Pine, Victor and Boynton (HBR, Sept-Oct '93) and 'Variety is Free' by Goldhar and Lei (Academy of Management Executive, 1995v.9n.4).

And so here we are – manufacturing is becoming a service and services are acting more and more like factories. (One might also want to speculate how and where education might be placed on this spectrum.) Perhaps this convergence is inevitable – driven by the ambidextrous, but often conflicting, search for both improved profitability and increased responsiveness to customer demands and the evolving competitive marketplace.

Two recent examples reported in the news support this observation. First is the case of Starbucks which, in its efforts to grow from one store to 1,000 to 13,000 (today) to 40,000 in the future has, in the words of its founder; 'lost the romance and theatre' of the traditional Italian espresso makers which have been replaced by automatic machines. As customers can no longer see their drinks being made they no longer have what Howard Schultz calls, 'An intimate experience with the Barista'. The

stores, he says; 'No longer even smell like coffee' as in-store bean grinding has been replaced by 'Flavor-locked packaging'. (The Washington Post, 3/4/07 pA9). Is this move to a 'factory' decoupled model of the operating system inevitable with growth? Perhaps it is? We shall see; as Dale and Thomas Popcorn, a New York City 12 store business with currently a major web based distribution of 'upscale' Popcorn treats – 'Moving popcorn from a commodity to an experience' and 'To do to popcorn what Starbucks did to coffee' in the words of its Founder, expands to roll out 400 more stores in the next 3 years with a major capital investment from Goldman Sachs (TIME, 3/12/07 p. G6).

How then shall we define a 'true' service and differentiate it from a 'factory' or a 'product' in a useful way? The tangible vs. intangible distinction is not helpful as many services are quite physical and tangible (eg, a haircut) while others involve only information or entertainment.

So, how will we know one when we see/get it? For example: when is an Egg Salad Sandwich the result of a service operation versus a factory output? When is the customer/user getting a service as opposed to being the Work-In-Process inventory? Certainly the traditional distinctions outlined in Sampson and Froehle are a good beginning but we need to go beyond.

The question we believe is not: 'What is a service product/process?' but rather 'WHEN is it a service?' An Egg Salad Sandwich may be mass produced on a repetitive work, continuous flow production line – perhaps even automated; or it can be the 'one-off' result of real time communications between the customer/eater and the waitperson or food service worker

(who might be a family member or a caregiver) as to how much mayo should be in the mix, pickle or pimento or celery, salt and/or pepper, on white or rye or whole wheat, toasted or not, how thick, cut in halves or quarters, cut on the square or diamond, etc., etc., etc. But it is still an Egg Salad Sandwich with roughly the same level of nutrition as the factory made product obtained from a vending machine. They are, however two entirely different ‘experiences’ for both the producer and the customer. Obviously the economics, technology and operations management of the two examples are very different and one can imagine a wide range of products/services/experiences and levels of cost/price and customer satisfaction in between.

Where to from here? We suggest the need for new thinking about the curricula and course designs in both Industrial and Systems Engineering and Production and Operations Management to eliminate the traditional distinctions between products and services and to develop a set of tools and concepts (some old, some new, some borrowed,...) that use a spectrum approach: from ‘traditional’ product to ‘true’ service outputs/outcomes versus a vector of organization structure options ranging from the traditional factory to a true service process with hybrid systems such as supply chains/distribution channels, crafts and ‘experiences’ (eg. a concert) in between.

In the end its all ‘Production’ but the economics, process and task designs, management tools and skills, organizational structure, HR policies, use of technology, allocation of decision rights and the design of control/information/reward systems; will be very different and will need to be carefully ‘tuned’ to the particular business model and strategy. The strategic choices of what customer to serve, what problem we

solve for them and why they should come to us will, in the final analysis; drive the design of the operating system and the choice of technology. The challenge is to develop a structure to implement the strategy that allows for differing levels of service and factory operations in the same system.

We can begin this effort, we suggest; by looking at operations from an Organization Theory and Design perspective. Consider that organizations/operations have two fundamental dimensions; physical and organizational/legal. Therefore operating systems/organizations may be either ‘coupled’ or ‘decoupled’ both physically and organizationally. For example a traditional factory organization might be seen as ‘double decoupled’ from its customers while a true service is ‘double coupled’ with its customer who must be there to get the service and is often the employer of the service provider. In-between are situations we might call ‘experience’ products where the producer and customer/user are physically coupled but organizationally decoupled or a supply chain where producers and users are physically decoupled but organizationally, or at least legally/contractually closely coupled. Think of this as a continuous spectrum with every possible combination and degree of physical and organizational ‘coupling’ are possible. For example, hiring a maid is a true service situation but ‘Maid-for-a-Day’ decouples; at least to some degree, the buyer/user of the service and the producer/worker. When they can give you a check-list of what their service people will do and when they will do it – it looks more like the repetitive work design of a factory.

So, how can we begin to develop new models of operations systems design that integrate factory and service production and product and service outputs? We suggest

that this will require two major changes in our thinking – at least from an academic point of view. First the closer integration of teaching in the areas of Operations Management and Marketing; especially the use in OM of marketing based models of product design developed from the perspective of the customer/user. Take, for example, the concept of an ‘Experiential’ product such as a Broadway play. Is the play a service or is it indeed a product produced by a factory workforce and system based upon repetitive work, narrowly defined tasks and time standards, following a strictly enforced sequence of tasks? Second; we need to increase our use of the concepts and tools from Organizational Behavior and the Cognitive Sciences in Operations Management and Industrial Engineering as we think about the development of ‘effective’ organizations and operating systems. (Tien and Berg ‘A Case for Service Systems Engineering’, *Journal of Systems Science and Systems Engineering*, 2003)

Essentially we need to give ‘Sociotechnical Systems Theory’ (Systems Analysis in Organizational Behavior by John A. Seiler, Irwin-Dorsey Series in Behavioral Science, Irwin Press, 1967) equal weight with mathematical tools and optimization theory in both education and in practice.

Overall, we need new language, new models, new concepts and new case examples to train the next (and the current?) generation of Operations Managers as well as General Management to focus on ‘organizational/operational effectiveness’ and business profitability; no matter where they are on the spectrum from product to service to experience. In effect; every output/outcome is a ‘service’ to some degree. The distinction is in the ‘balance’ of factory vs. service process elements and

WHEN the output/outcome switches from a product to a service in the eyes of the customer/user. We suggest that the NEW MODEL of Operations Management and Industrial and Systems Engineering will be based upon the following Variables:

- Predictability of Demand, Supply and Variety
- Simultaneous satisfaction of both variable demand and variable supply (including the variability in behavior of both the producer and the variable customer/user) (see Tien, Krishnamurthy and Yasar).
- Interchangeability of capacity and inventory
- Potential for Economies of Scale vs. Scope
- Level of Flexibility, Variety, Customization, Speed, Robustness and Responsiveness
- Degree of Customer/User Control over the Product Design and The Sequence and Scheduling and Design of Tasks in the Production Process; and, most importantly, The Employee Reward System

We suggest that these variables can be the basis for the development of a new generation of Operations Management and Industrial Engineering tools and concepts that will move us toward a better understanding of the design of operations and the connection of operations and technology management to business and corporate strategy; that will result in greater satisfaction to customers/users combined with greater profitability to business.

In summary – to answer the question we implicitly asked in the title to this position paper: **IT CLEARLY IS A SERVICE WHEN THE PROCESS IS THE PRODUCT AND WHEN THE**

CUSTOMER/USER IS IN CONTROL OF BOTH THE DESIGN OF THE OUTPUT/OUTCOME AND THE MANAGEMENT OF THE PROCESS.

This happens *when* process knowledge is clearly integrated with the operating system; *when* the customer

controls the reward system to the service provider and *when* both the user/customer and the provider/worker/technology are part of the same Socio-Technical system.

References

1. Chase and Garvin, 'The Service Factory', HBR, July-Aug, 1989.
2. Chopra and Laviviere, 'Using Service Inventory to Push Performance', SMR, Fall '05.
3. Goldhar and Jelinek, 'Plan for Economies of Scope' HBR, Nov-Dec, 1983.
4. Goldhar and Lei, 'Variety is Free', Academy of Management Executive, Vol. 9, N. 4, 1995.
5. Goldhar and Jelinek and Schlie, 'Flexibility and Competitive Advantage: Manufacturing Becomes a Service Business' IJTM, 1991.
6. Levitt, T., 'Production Line Approach to Service', HBR, Sept-Oct, 1972.
7. Levitt, T., 'The Industrialization of Service', HBR, Sept-Oct, 1976.
8. Pine, Victor and Boyton, 'Making Mass Customization Work', HBR, Sept-Oct '93.
9. Quinn, Baruch and Paquette, 'Exploring the Manufacturing-Services Interface', SMR, summer 1988.
10. Quinn, Dooley and Paquette, 'Beyond Products: Service Based Strategy', HBR, March-April, 1990.
11. Roth and van de Velde, 'Operations as Marketing: A Competitive Services Strategy', JOM, Aug'91.
12. Salgo P., 'The Doctor Will Se You for Exactly Seven Minutes', New York Times, Op-Ed, 3/22/06.
13. Sampson and Froehle, 'Foundations and Implications of a Proposed Unified Services Theory', Production and Operations Management, Summer '06.
14. Seiler, John A., 'Sociotechnical Systems Theory', Systems Analysis in Organizational Behavior, Irwin-Dorsey Series in Behavioral Sciences, Irwin Press, 1967.
15. Tien and Berg, 'A Case for Service Systems Engineering', Journal of Systems Science and Systems Engineering, Vol. 12, N. 1, 2003, pp. 13-38.
16. Tien, Krishnamurthy and Yasar, 'Towards Real-Time Customized Management of Supply and Demand Chains', Journal of Systems Science and Systems Engineering, Vol. 13, N. 3, September 2004.