
AC 2011-72: PRODUCT AND SERVICE DESIGN BUNDLE: A CURRICULUM FOR TEACHING MANUFACTURING COMPETITIVENESS

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Product and Service Design Bundle: A Curriculum for Teaching Manufacturing Competitiveness

1. Background

The employment in the manufacturing industry in the USA has been declining since the 1990s and it is likely to continue in the next decade, the latest data from the Bureau of Labor Statistics (BLS) suggests. Here is a relevant extract from the Occupational Outlook Handbook¹ published by the BLS: Overall employment in manufacturing sector will decline by 9% during the period 2008 – 2018 as productivity gains, automation, and international competition adversely affects employment in most manufacturing industries. Employment in household appliance manufacturing is expected to decline by 24% over the decade. Similarly, employment in machinery manufacturing, apparel manufacturing, and computer and electronic product manufacturing will decline as well. However, employment in a few manufacturing industries will increase. For example, employment in pharmaceutical and medicine manufacturing is expected to grow by 6% by 2018; however, this increase is expected to add only 17,600 new jobs.

On the other hand, the same report suggests that the shift in the U.S. economy away from goods-producing in favor of service-providing is expected to continue. Service-providing industries are anticipated to generate approximately 14.5 million new wage and salary jobs. Similar to goods-producing industries, growth among service-providing industries is expected to vary as shown in Figure 1.

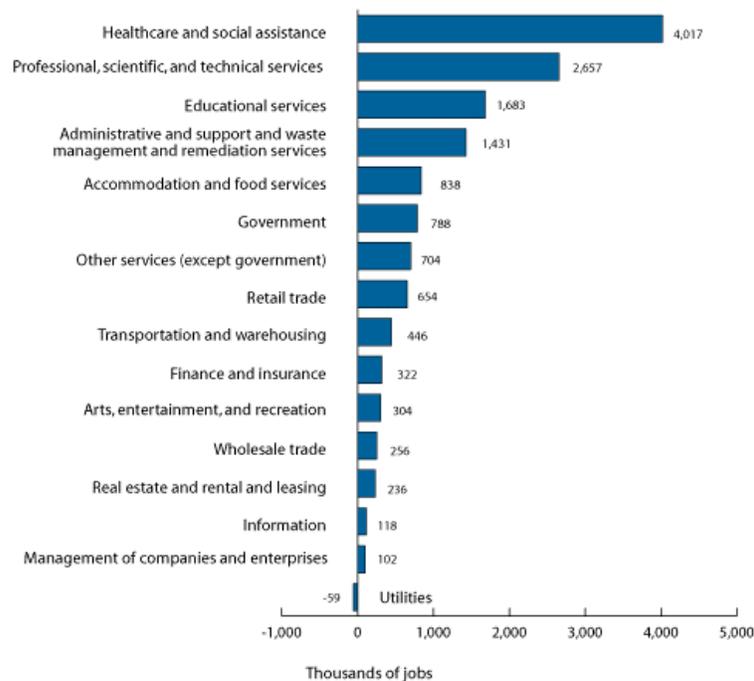


Figure 1: Projected change in employment in service providing industry during the period 2008 – 2018 (Source: BLS).

These data sets suggest that the manufacturing industry should rapidly change its face in the US where the majority of the manufacturers must re-evaluate service aspects of their business in order to remain competitive in a global economy. This may be viewed as both a challenge and an opportunity for academic institutions involved in preparing the labor force needed to deal with these changing economic circumstances. It is a challenge because the traditional design curricula across the board focus almost exclusively on product design²⁻⁴ and the topic service design hardly ever gets a mention in undergraduate schools. This leads to the situation that the new graduating engineers will not be trained for the contemporary and emergent needs of the manufacturing businesses. This situation thus presents an opportunity for curriculum development where Service Design and Development should become an integral part of the design education. The topic of service design and development must be viewed as a very important step in creating value, delivering satisfaction to the customer and sharpen the competitive edge for the manufacturers and therefore should become one of the focal points of undergraduate engineering education.

In accordance with the ideas outlined above, a new curriculum is developed to bridge the identified educational gap by developing and delivering a three credit course called 'Product and Service Design' in the Summer 2010 term. The developed course curriculum is described in detail in this paper. The curriculum includes the discussion on several case studies covering diverse industries such as IT, software, hardware manufacturing, banking and finance, and customer goods manufacturing where the company strategy was fundamentally changed to accommodate service aspects of the business. The companies developed innovative strategies to market and deliver service to the customers as if it were a product for increasing profitability of their organizations. Several techniques of service design including service blueprinting are included in the curriculum. Testing of service products for quality assurance are identified and discussed. Best practices for product design such as delivery, flow charting, failure modes, effects and criticality analysis, feedback mechanisms, are adapted as an integral part of the service design process. A term project was assigned in the course where concepts learnt in the class were applied to real world problems to see how effective they were when the traditional product manufacturing business incorporated service products in their portfolio. The course was initially developed as a graduate course but it is now being adapted for an integrated BS/MS or traditional undergraduate degree in manufacturing / mechanical engineering.

2. Course Management

2.1 Course Description

Compare and contrast different methodologies employed in the design of an engineered product and a service product offered by a business. Understand the critical roles of the customer, competitiveness and corporate strategy in the design and management of new products and services.

2.2 Course Objectives

To develop an understanding of *product design and development* process including customer needs analysis, innovation and creativity, concept selection, industrial design, product architecture, design for manufacturing and assembly, prototyping, product teardown and benchmarking, intellectual property and design protection, cost estimating and reverse engineering. To develop understanding of the four key elements in *service design* process including compelling customer experience, funding mechanisms, employee management system and customer management system. The course is designed as a three-credit, 6th semester (i.e. junior year) elective course for manufacturing and mechanical engineering majors. The student assessment tools employed were:

- Six take-home assignments, 5% each = a total of 30% towards final grade
- A term project = 30% towards final grade
- Mid-term written exam, 20% towards final grade
- Final comprehensive written exam, 20% towards final grade

2.3 Course Curriculum

Following points were included in course curriculum dealing with service design:

- Role of Services in an Economy
- Nature of Services
- Service Strategies
- New Service Development
- Integrating Technology in Services
- Service Quality Assessment and Maintenance
- Supporting Facility and Process Flows
- Service Process Improvement
- Service Provider-Customer Interaction Management
- Service Facility Location
- Service Supply Chain
- Globalization of Services

A suitable textbook that covers these topics was identified as follows: *Service Management: Operations, Strategy, Information technology*, 7th Ed., 2011, J. A. Fitzsimmons and N. J. Fitzsimmons, McGraw Hill Irwin, ISBN 978-0-07-340335-9. The textbook neatly covers all important aspects of service design with ample real world examples.

3. Course Delivery

The course delivery consisted of various pedagogical tools including formal lectures, a set of case studies followed by guided group discussion, a term project and traditional pen and paper exams. The case studies were selected based on the research conducted by the faculty member to determine their appropriateness in the context of course curriculum.

The case studies were selected from the published case studies in Harvard Business School. A brief description of the chosen case studies is given below:

3.1 Case Studies:

A case study was assigned each week that dealt with different aspects of service design and development⁵⁻¹⁴. The overarching message of every case study was that the concerned corporations felt the need for developing service products to be able to compete in the global market place and survive. Many companies that were traditionally hardware manufacturing industries had to rediscover themselves and retrain personnel to be able achieve this product-service hybrid business model. Discussion questions were devolved for each of these cases and class time was provided for guided discussion sessions to elaborate on the key ideas. Some of the cases selected had the following themes:

- Identifying the most important elements for a successful service business
- A challenge for a hardware manufacturing company to develop corporate strategies to become more customer focused rather than technology focused
- High quality customer service as a competitive strategy by *WOW!ing Customers*
- How to create and serve profitable customers
- Innovative strategies for new service products in insurance company
- A service oriented company diversifies to incorporate hardware products for market expansion
- Developing hardware and field service bundles for important corporate clients
- Collaborating with customers for on new product introduction
- How to build and sustain a customer-centric corporate culture
- Managing the transition from a product-oriented to a service-oriented company

3.2 Term Project:

The students were asked to pick any traditional manufacturing company for analysis. They may also choose the company where they may have worked in the past or they are currently working for in any capacity – as an intern or work study student or in any other capacity. They need to identify at least one service aspect that the company may explore for launching commercially. The project involves identifying and evaluating several business opportunities for developing service product for the company. They would identify service process flows, personnel and technology requirements, quality issues, and service flow charting. The project report is expected to cover the following topics at a minimum:

- Introduction / Rationale
- Background / Literature survey
- Product and Service Bundles – alternatives
- Data collection / Analysis
- Discussion
- Conclusions
- Future work

- Acknowledgments
- References

4. Applicable ABET Outcomes

Criterion 3 ABET outcomes applicable for this course are suggested as follows:

Graduates have:

- (2): an ability to apply knowledge of mathematics, science and engineering
- (3): an ability to design a system, component or process to meet desired needs
- (5): an ability to identify, formulate and solve engineering problems
- (7): an ability to communicate effectively
- (10): knowledge of contemporary issues

Manufacturing Engineering track-specific ABET outcomes applicable for this course are suggested to be:

Graduates:

(M2): have proficiency in process, assembly, and product engineering and understand the design of products and the equipment, tooling and environment necessary for their manufacture

(M3): appreciate the necessity for manufacturing competitiveness and understand how to create competitive advantage through manufacturing planning, strategy and control

The outcomes may be assessed *via* homework assignments, term project and exams. The applicable outcomes list should be revised based on the outcomes assessment.

5. Course Assessment

The course assessment was done through student feedback survey. Some of the comments on different aspects of the course are given below:

The course was neatly planned with stated objectives for every week, case studies and chapters were laid out before the beginning of the course. To put things into perspective, product development was also covered, so we could compare the differences and similarities of service and product development. Weekly meetings covered what was read in during the week – case studies and relevant chapters, we discussed on the case study and the chapters were used to correlate theories.

Work load was a little heavier than usual and that helped to keep us on track of aggressive schedule that an independent course demands. We had ample of material to cover including overview of product development, case studies and Service Management text chapters, the course also had term paper as an final assignment. Work load involved readings of case studies, text chapters, online material and assignment questions. The work load helped in focusing on the course objectives and not to get digress on others topics. The workload was properly and adequately supervised in a timely and consistent

manner. Proper feedbacks were available and key learning points were highlighted during the weekly meetings

We covered the service management concepts, strategies, tools, technologies and methodologies for NSD, operations, quality improvement, globalizations. Along with the Operations and strategy for Product companies to develop service models, course also covered hybrid strategies and pure service strategies. Overall course met the objectives of understanding the Service development and management for product / hybrid / pure service based businesses.

The course did create a curiosity to investigate more. It opened new avenues to study. With recession making a permanent mark on our economies and questioning the way we do business, companies will face new challenges in selling products and/or services in global market with different currencies, different culture and globalized resources and old strategies that worked before may not fit in.

6. Summary

It was recognized that an educational gap exists between traditional undergraduate engineering design education and the current market trends for employment growth. Manufacturing sector is experiencing a major shift from goods manufacturing to service industries in the USA. Therefore a new course curriculum was designed and developed to incorporate service design as a key component of the curriculum. The course contents were delivered via traditional text book and lecture method as well as case studies and discussions. Many real world applications were studied to identify service product opportunities for traditional; manufacturing corporations and the strategies needed to reorient the corporate culture towards service aspects of the business. The curriculum was initially delivered as a graduate course but can be delivered as an undergraduate three credit elective course in manufacturing and mechanical engineering. The student feedback was positive where it was recognized that the course content was appropriate in its depth and breadth to effectively address the urgent needs of the US manufacturing sector striving to remain competitive in a globalized economy.

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