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A research of Service-oriented Industrial Engineering Specialty Core Curriculum Configuration

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Abstract. The integration service science to industrial engineering is necessary because of manufacturing servitization. First, the ability of industrial engineering is analyzed, the results show that the ability of communicating, the use of knowledge management for service innovation ability, application ability of science and technology information have relation with services science. Second, 12 services science curriculum match to required capacity using QFD model ,we find that introduction to scientific service, service design and innovation, service management, service operations management and service information and automation are particularly critical. Finally, this paper puts forward a service-oriented industrial engineering specialty curriculum framework of colleges, and the goal of core curriculums are defined and described.

1. Introduction

Service science is an interdisciplinary discipline that integrates science, engineering, and management. Service science is mainly to analyze service problems from a scientific point of view, actively promote innovation and improve the productivity of the service industry. The application of service science has become the major development trend of the service industry in most countries in the world [1]. With the trend of intelligent manufacturing industry, the traditional manufacturing industry has begun to transform into service, and the integration of service science into the field of industrial engineering has become the focus of research and hot issues in recent years.

At present, the domestic industrial engineering subject has encountered unprecedented development opportunities, and the demand for talents has increased sharply. The growth of talent demand has promoted the development of such disciplines in colleges and universities. The higher education of industrial engineering in China has a history of more than ten years, more than 160 colleges and universities have set up industrial engineering specialties [2]. Although foreign universities have begun to pay attention to the integration of service science and industrial engineering courses, these studies lack the application of scientific and systematic research methods, resulting in the gap between the establishment of curriculum connotation and the talent capacity required by the service industry. In order to make up for the insufficiency of these researches, the service science and industrial engineering courses are integrated and connected with the industrial engineering demand capabilities based on the analysis of expert advice in the field of domestic service science and industrial engineering. The construction of an industrial engineering curriculum framework and core curriculum based on the service science has certain reference significance for the undergraduate course setting of the domestic industrial engineering major.

2. Service Science Development in Industrial Engineering

Industrial engineering disciplines include five major areas of service system design and operation management, production systems, human factors engineering, operations research and information systems [3]. In addition to manufacturing as the basic support for the research of existing manufacturing systems, more and more industries are gradually forming a service-based trend. Regardless of whether physical products or intangible services are provided, it is necessary to cover the needs of customers and provide high-quality products and services with the main body of service

systems and management as the framework to achieve the ultimate goal of customer-centricity. Therefore, it is necessary to integrate the professional knowledge of human engineering into the design of product and service system and realizes the experience of innovative products guided by customer demand; not only do enterprise products need to provide intangible services, but also high quality physical products are a very important part. In order to strengthen the competitiveness of the overall product, the optimization of the production system is still the core value and goal that the industrial engineering discipline continuously pursues. In order to improve the overall competition of the manufacturing industry and the service industry, the research on the basic method, the decision model and the advanced information technology needs to be continuously strengthened. The two sub-disciplines of Operation Research and Information System have a key supporting role and can improve and strengthen the overall competitiveness of various types of industries. The continuous development of various sub-disciplines of industrial engineering has important value for the development of China's economy, innovation, and science and technology, as shown in Figure 1.

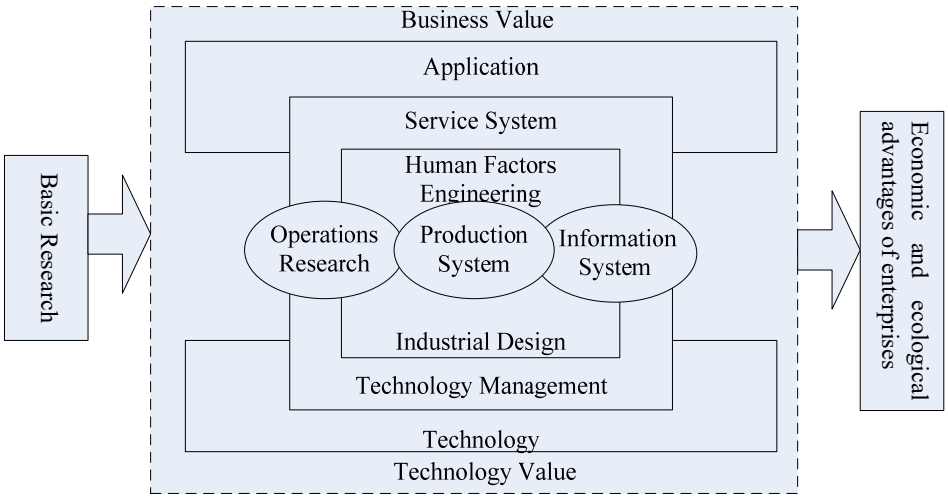

Fig. 1. The research field of Industrial Engineering

Service system design and operation management have gone through four stages: the embryonic period, the independent period, the development period, and the dominant period. Now it has become the most dynamic research field in the industrial engineering discipline [4]. With the rapid development of the service economy, how to convert the experience and technology of industrial engineering in the production and management of manufacturing industries to the problem solving in the service industry is the main research topic of the service system, the problems in the service industry are characterized by differences, intangibility and non-storage compared with the manufacturing industry. Therefore, we must carry out basic research on service systems. These studies include general issues of service systems in the field of industrial engineering, service design, service supply and demand analysis, and service resource planning, service R&D management, service system design, and service system operations management, service performance management, service science and so on.

3. Exploration of Setting up Courses of Service-oriented Industrial Engineering

In order to ensure the effectiveness and practicality of the research results, this study carries out a predictive questionnaire for experts and scholars based on the field of industrial engineering. The surveyed subjects are mainly university teachers engaged in teaching and research of industrial engineering. Subsequently, the QFD is used to develop the model to achieve the docking of professional demand ability and service courses. The advantage of the QFD is to transform the

abstract demand of the customer into the quality control point that the enterprise can recognize, and then greatly improve the quality of the enterprise product.

Twenty universities and colleges which have set up specialties in industrial engineering have been screened out. E-mails were used to conduct questionnaire surveys. A total of 180 questionnaires were sent out, and 106 people responded. The response rate was 58.89%, 102 questionnaires were valid questionnaires. According to the results of the questionnaire, it was found that the ability of demand analysis and communication (A_1), the ability to use knowledge management to carry out service innovation (A_2), and the ability to apply scientific and technological information application (A_3) were strongly associated with the service science [5]. It is the input of the model as the quality function. In the QFD analysis, the customer demand weight has an important influence on the optimization of key indicators and the subsequent configuration decisions. This study used expert scoring to determine the weight of demand. According to the study of the service science, 12 basic courses of service science are summarized, including the introduction of service science, service job management, innovation management, thematic discussion on services, service design and innovation, service engineering, service calculation, knowledge management, product design and development management, service economy, Electronic commerce, service information and automation[6][7]., A QFD model is established based on the above elements, as shown in Figure 2.

Through the analysis results of the QFD, it can be seen that the six courses of introduction to service science, thematic discussion on services, service design and innovation, service operations management, service job management and service information and automation are the core professional courses that meet the demand. In order to strengthen the role of service science in the industrial engineering profession, this study proposes that these courses be offered in the industrial engineering majors of domestic universities and colleges in the future. The study proposes a professional engineering curriculum framework based on service science, as shown in Figure 3.

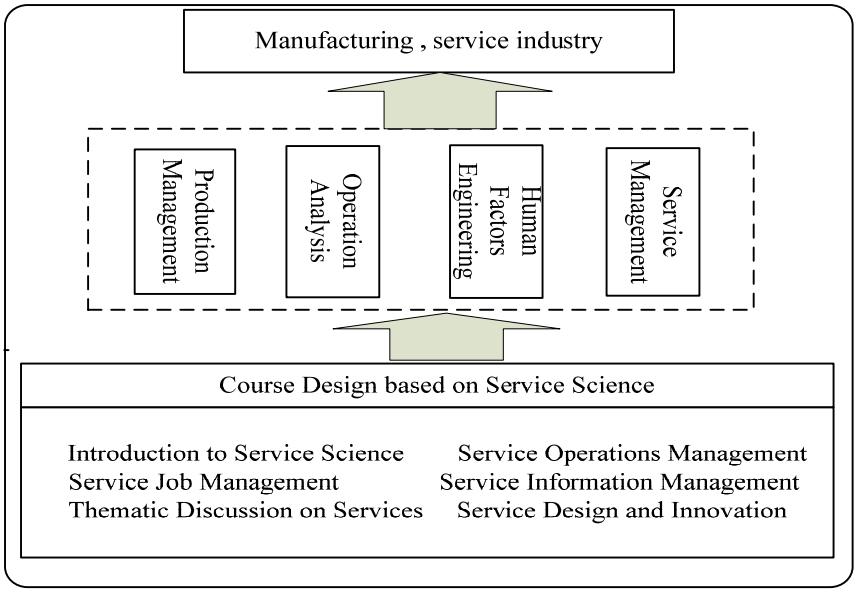

Fig. 2. Core Curriculum Structure of Service-oriented Industrial Engineering

	Related courses / Need ability	E-commerce	Service economy	Introduction to Service Science	Thematic Discussion on services	Service Design and Innovation	Service Operations Management	Service Job Management	Service Information and Automation	Service Engineering	Product Design and Development Management	Service calculation	Knowledge management	Demand weight
A_1	The ability to divert demand and make configuration meet the demand service		○	◎	○	◎					◎		△	7
	The ability to collect, collates, analyze and apply data	◎		◎		◎	◎	○	◎			◎	○	5
	The ability to communicate, cooperate and lead with different professional	○		◎			○			△	○			7
	The ability to plan and execute the service design project separately				△	◎	○	○						5
	The attitude and spirit of continuous learning		△							△			△	7
A_2	The ability to understand the connotation and practice of service science	○	△	◎	○		○	○		△				9
	Use of management knowledge to solve professional management problems	△					◎						◎	9
	The ability to adapt, integrate and innovate	△		△	◎				◎			○		5
	The ability to create, mine, analyzes, diagnose and solve problems							◎	◎					9
A_3	The ability to develop, implements , and improve systems				◎		△	◎	◎	◎	○			7
	The ability to integrate resources to solve problems				◎	◎	◎	◎			△			9
	The ability to use the network to work together	○		◎	○	◎	◎	◎	◎		○	◎	○	9
Total features		134	34	338	269	315	358	363	315	86	141	81	137	
Sorting		9	12	3	6	4	2	1	5	10	7	11	8	

The relationship matrix is represented by ◎, ○, and △, which respectively correspond to the numbers 9, 3, and 1.There is no relationship, and the corresponding number is 0;

Fig. 3. The Core Curriculum of Service-oriented Industrial Engineering Based on QFD

4. Analysis of key courses

As shown in Figure 3, the professional basic courses of service science are integrated into the field of production management, operations research, human factors engineering and service management in the field of industrial engineering. The field of personnel service training in industrial engineering specialty is extended to service industry, which has far-reaching significance for service industry and manufacturing industry. In order to understand these courses, the connotation of these courses is further defined and explained, as shown in Table 1.The service science curriculum proposed in this study will enable the industrial engineering students to obtain sufficient basic knowledge of service science, and also allow students to understand the significance of the application of service science to the development of industrial engineering on the basis of the professional knowledge of industrial engineering.

Table 1. Connotation of professional courses in service

Course Title	Curriculum connotation
Introduction to Service Science	On the basis of related courses (business management, enterprise resource planning, project management, software engineering, etc.), understand the basic concept of service, understand the characteristics and development trend of modern service industry, and be familiar with the theory and technology system of the three branches of service science, service management and service engineering.
Thematic discussion on services	It introduces the characteristics of service operations and the basic theories and methods of operation management, and discusses important issues in service operation management through case analysis. The course covers the basic theories of service operation management, such as service quality design, service facility location selection and so on.
Service Design and Innovation	The problem of service industry is complex and changeable, and the service development process with innovative ability is also more important. The curriculum includes the application of design methods and the practice of service design projects. Through the introduction of design thinking, an innovative service platform is proposed to enable students to understand the processes, methods and tools related to service design, and can be used in practice.
Service Operations Management	The course is a service marketing course. Students will explore the use of marketing concepts, frameworks, and models to analyze different types of services, and help to formulate and implement corresponding marketing strategies. It analyzes the service factors that influence consumers marketing communication, motivation, perception, image, brand and so on, and improves business services continuously.
Service Job Management	The course mainly discusses the operation mode of the service and how to solve the problem of inefficiency and lack of quality service. The focus includes the design of service strategies, service products, service processes, production planning and human resource management.
Service Information and Automation	Service information and automation is a new interdisciplinary subject, which mainly studies the application of science and technology in business services. This course enables students to understand the related technologies and theories of Web services, and learns to use the design service process to build enterprise's service information system.

5. Conclusions

The rapid development of the service economy and the service-oriented manufacturing industry all require the support of service science. Firstly, the needs of the industry engineering service sciences were investigated and analyzed. The results showed that the three types of capabilities of demand analysis and communication capabilities, the ability to use knowledge management to carry on the service innovation and the application capabilities of science and technology information have a strong connection with service science. Then we use the quality function deployment model to connect these requirements with the service class. The results show that 6 courses are the core courses of service science, such as introduction of service science, thematic discussion on services, service design and innovation, service operations management, service job management and service information and automation. In order to strengthen the integration of the subject of service science and industrial engineering, it is suggested that these courses be set up in the industrial engineering major of the universities and colleges in China, which is of great significance for the training of the professional talents of service type industrial engineering.

Acknowledgements

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