

Service Science Education for Industry Employability in Management Engineering: An Integrated Pathway from Bachelor to Master Level

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Abstract. The School of Industrial Engineering at LIUC Università Cattaneo offers Bachelor's and Master's degrees in Management Engineering, carefully designed to nurture engineers with managerial skills. The curriculum combines fundamental areas like mathematics and physics with advanced topics, including innovation management, organizational design, marketing, and operations management. The program stresses five main areas: analysis, design, implementation, validation, and management, preparing students to apply engineering methodologies to complex processes in various contexts. A unique Business Services specialization focuses on equipping management engineers for the service sector and steering digital transformation in businesses. The undergraduate program includes modules such as Digital Enterprise Management and IoT Systems Design, while the graduate program incorporates Management Information Systems and offers optional courses. The school partners with Microsoft Italia, promoting educational innovation in digital business management using tools like MS Power BI and Azure cloud services. Offering a range of internships and international experiences, the School of Industrial Engineering at LIUC successfully secures an employment rate of 89.1% for graduates within three months post-graduation.

1 Introduction: The School of Industrial Engineering at LIUC Università Cattaneo

The School of Industrial Engineering at LIUC Università Cattaneo offers a Bachelor and a Master degree in Management Engineering. The School trains engineers with managerial competences leveraging on a solid theoretical background and a series of experiential activities that allow students to develop the necessary skills to understand the application to organizational domains of engineering principles and models. The traditional foundational subjects of the program at the undergraduate level (such as analysis, physics, computer

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science) are complemented with topics that cover innovation management, organizational design, marketing and operations management.

Analysis, design, implementation, validation and management are the five key areas which allow engineers to apply an “engineering method” in the economic, social and business context [1]. In addition, a modern view of organizations places emphasis on the transformation process of goods and supply of services [2]. Coherently with this findings, LIUC courses teach management engineers to apply the engineering approach to complex processes and in highly heterogeneous contexts, coherently with the general framework of the Service Science [3,4].

LIUC’s objective is not only to ensure a fast and adequate occupation to its students but also to shape the mindset of individuals able to contribute to the development of the organisations where they operate, ready to take leadership roles and positions of responsibility over time.

Among other orientations, since 2008 the School has been offering courses focused on management in the service sector and on digital transformation for businesses of any kind.

2 The Business Services specialization in the undergraduate program

The Business Services orientation is one of the specializations that a student at LIUC can choose on the third year of the undergraduate program in Management Engineering. Services are an intangible component of any business activity. In this course, students approach them from the perspective of design, performance measurement, and economic evaluation. The educational objective is to specialize graduates with advanced skills in the management and analysis of digital processes and digital transformation. Given the continuously evolving context of digital systems and information and communication technologies, the pedagogy of this orientation is highly pragmatic: the theoretical contents are presented starting from the discussion of real cases, and over half of the teaching takes place in workshops. Students work in teams to create physical prototypes of IoT systems they also use the most popular modules of SAP S4/HANA and practice the most advanced tools to develop big data analysis models. The syllabus is primarily taught in Italian, and includes three courses, described in the following sections.

2.1 Digital Enterprise Management

This course introduces the students the main characteristics of organizations dealing with the management of services. Besides describing the service sector, the course places emphasis on the “service”-components in manufacturing companies. Moreover, students have the opportunity to practice the management of services by means of an ERP system. The course also aims to develop transversal skills like problem-solving and effective communication. The course is divided into three topics: services and key services dynamics (servitisation, service dominant logic), SAP (hands-on lab on the key modules of SAP S4/HANA) and design thinking for service design. During the course the students use an ERP system specially designed for didactic purposes so that they can experiment the logical flow of the life cycle of the production of goods and/or services.

2.2 IoT systems design and development

This course aims to teach students the necessary skills for designing and developing Internet-of-Things (IoT) systems to support business processes. The course introduces IoT

systems, open hardware tools and open-source software like Node-RED for creating IoT systems, and sensor and actuator integration logic. After that students are introduced to cloud platforms, formalisation techniques for process requirements, and technical system specifications. Students are then taught about designing IoT system architecture and creating IoT system prototypes to support specific business processes.

2.3 Business services design and measurement

The course aims to develop the theoretical and practical skills needed by managers so that they can make the best strategic and timely decisions based on different types of data from multiple sources. Students are introduced to big data and to the business applications of analytics tools, including data modelling and data visualization. This latter topic is complemented by a module on services design, where the students learn the role of the key design principles in the design of digital services and systems. The students perform hands-on exercises with analytics and data mining no-code/low-code software tools: students are assigned business cases accompanied by datasets. This approach enables the hands-on application of unsupervised and supervised machine learning techniques to solve specific problems.

3. Service science courses for graduate students

The Business Services specialization is integrated with a further compulsory course for graduate students – Management Information System, which provides basic notions regarding information technology (IT) and digital innovation, and aims to develop a deep understanding of the issue on information management and strategy within an organization and across organization in a supply chain or a cluster of firms. Moreover, it has been designed to develop the ability to analyse and manage business evolution in relationship to the adoption of IT in general.

The lectures cover the role of information and information systems (IS) within organizations, the relationship between IT and the structure and the processes and the strategy of the organization. Moreover, they put a focus on the sustainability of IS strategy and the IS strategic planning, on the software applications and IT systems for IS management, that is the role of "IT solutions" (e.g., ERP systems, KMS, CRM systems, etc.) regarding business processes and strategies. Furthermore, they take into account the IS development, the digital innovation (e.g., Internet-of-Things, Big Data and Analytics, RFID, etc.) and all the tools and frameworks shaped on individual cases and problems in order to handle the complex and systematic relationships of various functions and issue (e.g., feasibility study, business process modelling, etc.).

Another two optional courses complete the syllabus as long as service science is concerned: Natural and Artificial Intelligence for Business (NAIB) and Digital Ecosystem for Business Intelligence (DEBI).

The course NAIB is a management-oriented introduction to the evolving context of Artificial Intelligence (AI), with the aim of providing a conceptual framework of the technological scenario interpreted in the perspective of the business applications. During the course, both opportunities and risks of Artificial Intelligence are discussed, with the aim of strengthening business competences as well as critical tools of organizational and societal impacts.

The course DEBI explores the topic of digital ecosystems and their implications for business strategy and innovation to understand business intelligence and data sharing systems and principles for parties networked in a digital platform. The objectives of the

course are the acquisition of an in-depth knowledge regarding digital platforms and digital ecosystems in the fields of Information Systems and Innovation, the comprehension of the strategic perspective of digital platforms and processes of designing, the development of a deep understanding of the topics of information management, data analysis and sharing on digital platforms and through ecosystems.

4. Industry collaborations

The School of Industrial Engineering at LIUC Università Cattaneo is a trusted source of potential employees for companies thanks to four distinctive elements: a continuous interaction between the classes and the work environment, the focus on the management of innovation, the opportunities to enrich the learning path with international experiences and the attention to the progress of the studies of each student.

The School provides also several opportunities for growth through experiential workshops, students' visits to companies and testimonials by distinguished experts and managers working in a variety of industries.

In particular, a few years ago LIUC Università Cattaneo established a structured collaboration with Microsoft Italia to promote educational innovation in the area of employing digital technologies for business management. The collaboration began in spring 2019 with the adoption of MS Power BI on the Business Services specialization within the three-year Bachelor's Degree in Management Engineering and this was then used on many other courses, and by the School of Economics.

With the help of a Microsoft expert, students can imagine themselves in the organisational roles that manage business processes in sales and stock, procurement, and billing management.

Furthermore, the use of Microsoft Azure cloud services is introduced on the IoT systems design and development course during the third year of the Management Engineering degree's Business Services course.

The course enables students to design and create systems prototypes based on the Internet of Things. The services offered by the Microsoft Azure for Students platform are used to configure and administer the cloud infrastructure that assists their projects.

5. Service Science at work

Dynamic, open to change and thus forward-thinking, the students attending the School of Industrial Engineering at LIUC have a very young average age which means that they graduate at a lower average age than other universities in Lombardy and the rest of Italy. Students are offered a wide range of opportunities for internships and overseas experiences, which are cornerstones for lowering the rate of unemployment.

The main employment opportunities are manufacturing companies across all industrial sectors and advanced service providers, including consulting, in which graduates can work in information technology and work alongside management in decision-making processes. The employment rate of master students with a LIUC Service Science curriculum in the service sector alone is around 80% as per statistics of the LIUC Career Service office.

Moreover, according to surveys conducted by the Italian National Institute of Statistics (ISTAT), students enter the labour force three months after graduating and the employment rate for these graduates is 89.1%.

References

1. Fitzpatrick, J. (2017). Does engineering education need to engage more with the economic and social aspects of sustainability? *European Journal of Engineering Education*.
2. Stjepić, A., Juroš, L., Vugec, D. (2020). Mastering digital transformation through business process management: Investigating alignments, goals, orchestration, and roles. *Journal of Entrepreneurship, Management and Innovation*.
3. Kim, H. (2019). Service Science: Past, Present, and Future. *Journal of Service Science Research*, 11, 117-132.
4. Troisi, O., Sarno, D., Maione, G., Loia, F. (2019). Service science management engineering and design (SSMED): a semiautomatic literature review. *Journal of Marketing Management*, 35(11-12), 1015-1046.