

Learning for Placement.Fostering Innovation in the Construction Sector Through Public-Private Partnership in the Emilia-Romagna Region

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ABSTRACT

The Fourth Industrial Revolution increasingly deals with the application of new abilities, skills and workforce strategy as well as the introduction of new integrated technologies to support both productivity and innovation. The current research project carried out in collaboration between TekneHub, a research laboratory of the Emilia-Romagna High Technology Network, the Department of Architecture (DA) of the University of Ferrara and national and international public and private parties has focused on knowledge updating in the construction sector. The study was based on the application of both collaborative *Integrated Project Delivery Methods (IPD)* and *Value-Chain Analysis (VCA)*, which allow the most effective learning strategies to be identified in relation to industry needs, academia capability and placement requirements. Managerial knowledge and data based decision-making are certainly emerging as key findings in order to drive the Framework of Qualifications for higher education towards more contemporary and effective results.

Keywords: Construction management / Innovation management / Integrated Project Delivery Method (IPD) / Skills for Innovation in Higher Education.

INTRODUCTION

To ensure that new opportunities for increasing the productivity and the competitiveness of the construction sector determine a Fourth Industrial Revolution, it is not enough to introduce new technologies, such as automation in production processes and Internet of Things (IoT), or Advanced Materials.

At both national and European level, the construction industry has to deal with the inadequacy of job organization and skills in key areas, such as managerial knowledge, basic financial knowledge (ERA SGHRM, 2011) and data based decision-making, that are becoming even more crucial to make a new level of productivity effective. The upgrading of skills would allow the industry to “significantly contribute to job creation, by increasing its activity in some very promising areas such as the renovation of buildings” (EC, 2012, p.2).

Due to its slow innovation adoption, at both technological and organizational level, and the lack of collaborative work, associated with a variety of site-based project sizes, the construction sector has always been characterized by insufficient sharing of best practices among all the players and stakeholders involved, as often experienced in the Italian setting. Consequently, huge waste is still observed along the construction value chain.

“One reason for the industry’s poor productivity record is that it still relies mainly on paper” (McKinsey, 2016, p.7). Moreover, the fact that the construction industry invests less than 1% of net sales in R&D (EC, 2016) must be taken into account in order to understand the lack of innovation and technological progress.

For this reason, thanks to the reforms of the UK Government, the European States have recently undertaken actions to enable the development of a digital and automated production environment. In fact, since 2014 several codes and standards have become law and are being implemented. These include the sets of rules which refer to the adoption of Building Information Modeling tools; a set of ICT integrated tools for collaborative design and

management.

The first results of an ongoing research project can be found below, which aims both to measure the impact of digitization and automation in the construction sector and the reflections (effects) on the higher education system in the Emilia-Romagna Region, which is part of a national industrial cluster, strictly linked with the European market.

Considering the complexity of the players involved throughout the industry, the research project was based on the application of both collaborative *Integrated Project Delivery Methods* (IPD) and *Value-Chain Analysis* (VCA) to access, through quantitative and qualitative analysis, the correspondence between industry needs and public sector capability offering adequate higher education solutions to address placement opportunities.

The first results of the research project show that an integrated and collaborative approach to the upgrading of higher education solutions, helps to identify more effective strategies, in order to support the introduction of new skills and technologies in the construction sector.

THE STUDY: SKILLS FOR CONSTRUCTION INDUSTRY DIGITIZATION

Despite the increasing demand of digitized processes in the construction industry, “the sector is among the least digitized” (McKinsey, 2016, p.2). While the construction process is becoming more complex due to the amount of specialized knowledge that is necessary to effectively put a project in place, cost and schedule overruns are the norm.

This research study considers knowledge and Information Management (IM) as assets which are fundamental for the efficient and effective delivery of a project and which lead, if well managed, to better outcomes, including:

1. Increasing collaboration;
2. Improving the quality of data-decision making;
3. Enhancing the speed of decision-making;
4. Reducing duplication of effort;
5. Increasing business resilience.

The aim of the project is to investigate the quality of the regional higher education offer in order to verify the presence of knowledge areas such as the capacity to manage big data, creative thinking, complex problem solving and the risk management approach which have been identified as drivers for making the new industrial revolution effective.

In fact, according to *The Future of Job Report* “in many industries and countries, the most in-demand occupations or specialties did not exist 10 or even five years ago” (WEF, 2016, p.1) and one job type is mentioned, among others, across all industries and geographies: data analysts. In this new scenario, the skills set is expected to change rapidly according to industry needs so the “exposure to industry and other relevant employment sectors” (PIDT, 2011) becomes crucial right from the early stages of education, with particular reference to levels five to eight of the European Qualification Framework. It should be stressed that “the term industry is used in the widest sense, including all fields of future workplaces and public engagement, from industry to business, government, NGOs, charities and cultural institutions (e.g. musea)” (ERA SGHRM, 2011).

The finding of the study sample was based, first, on the definition of the target involved. In this study, higher education courses such as bachelor higher national diploma, bachelor, master and doctorate courses for architects and engineers were considered as main areas of the research. (Figure 1)

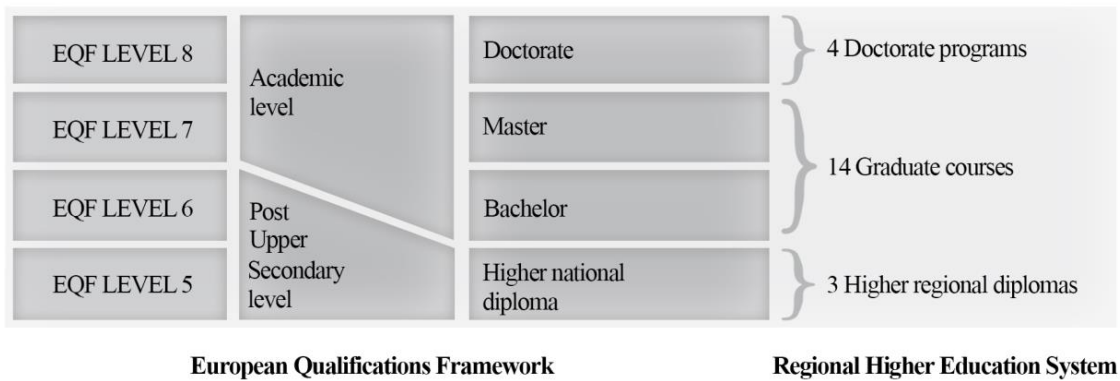


Figure 1: European Qualifications Framework and regional higher education system. Research domain. Secondly, criteria such as the representativeness from the territorial point of view were considered. In fact, higher education courses for the construction sector as well as continuing education and on the job training activities are an integral part of the regional education system. However, despite this scenario there is currently no common data set of information, either at regional or national level, which could allow the most effective strategies to be identified in order to meet the new placement opportunities. A long-term fallout of the study is certainly providing the regional sector with a comprehensive database of information regarding the quality of supply and demand of professionals in the construction sector. This purpose can only be pursued thanks to strong cooperation between the public and private players involved. In fact, the research project is carried out in collaboration between the regional “Association Construction Clust-ER”, which is regional a public-private initiative, the TekneHub centre, a research laboratory of the Emilia-Romagna High Technology Network, the Department of Architecture (DA) of the University of Ferrara and other regional, national and international public and private parties. (Figure 2)

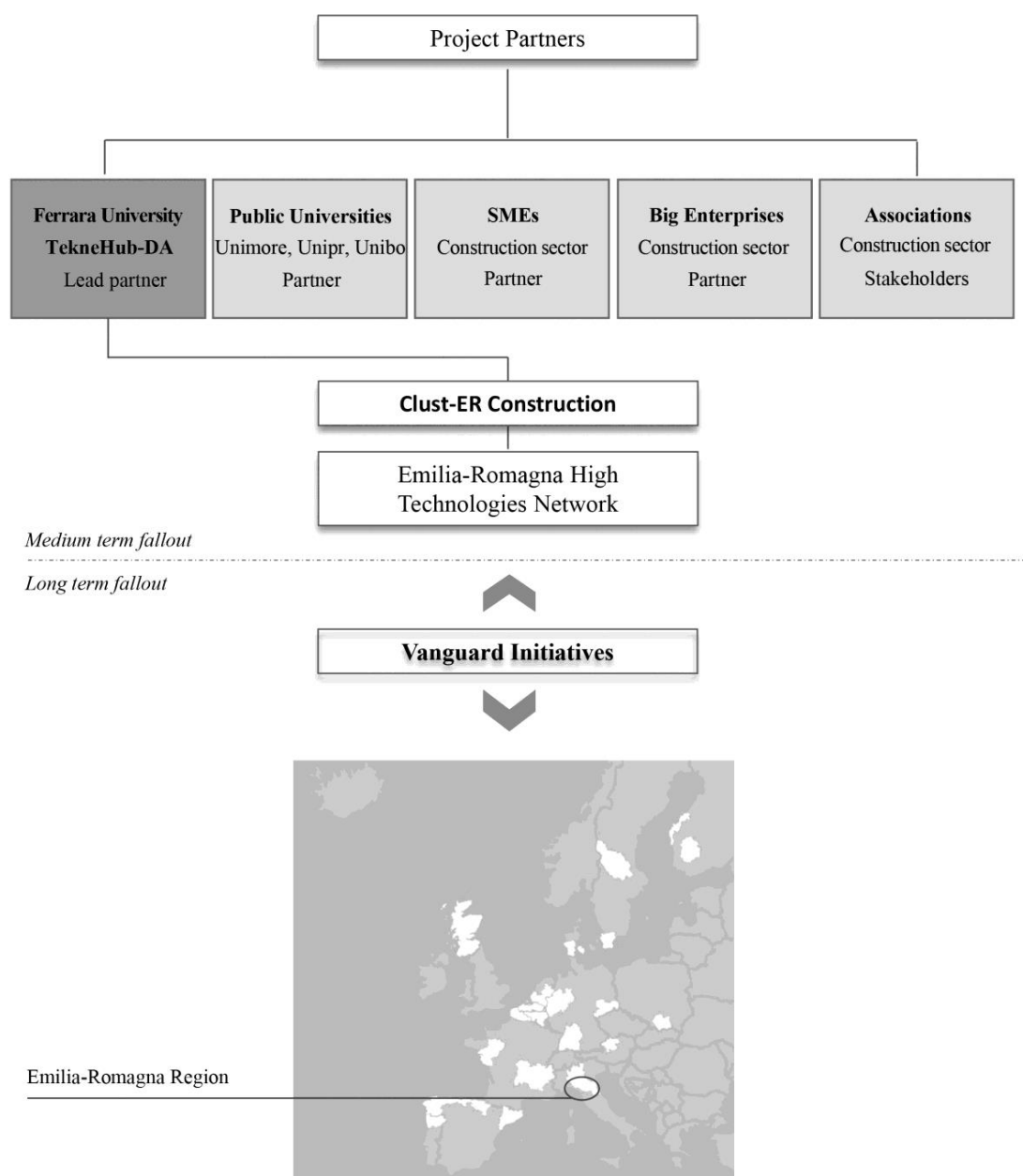


Figure 2: Projects partners. All the actors and stakeholders were involved at the early stage of the project

METHODOLOGY

As stated so far, the construction value chain is characterized by complexity, uncertainty, a fragmented supply chain, and short-term thinking which are obstacles for long-term innovation and learning (Oesterreich, Teuteberg, 2016, p. 123). However, Europe's Construction Value Chain (CVC) is a key industry, which accounts for 7% of European GDP, gross domestic product, and employs 11 million people.

Industry 4.0 requires, on the other hand, shared data-based knowledge which can only be reached through comprehensive data mining, data analysis and a risk management based approach along the entire value chain. As a result, the ability to manage this quantity of data became of crucial importance.

Subsequently, the research questions are as follows.

Research question 1: What impact does Industry 4.0 have on the regional higher education system in terms of

updating skills and competencies? (RQ 1)

Research question 2: Are regional and national Qualification Frameworks consistent with the needs of the current construction industry? (RQ 2)

Research question 3: Which teaching methods are suitable with reference to the target of the end users involved? (RQ 3)

Research question 4: Which new research areas are supposed to be of great importance for the future of the regional construction sector? (RQ 4)

During the initial stages of the research, intensive brainstorming activity was conducted with all the stakeholders involved and, within the IPD methodology, the research indicator sets were defined, such as:

- The target of students/end users involved;
- The set of skills and competencies related to the digitization process of the construction industry;
- The regional and National Qualifications Framework;
- The European Qualification Framework.

Furthermore, for the purpose of answering research question 1, the whole set of higher regional diploma, graduate, postgraduate and doctorate courses is undergoing analysis with respect to the following parameters:

- Basic project management knowledge;
- Advanced project management knowledge applied to specific subjects, areas and phases of the value chain;
- Basic risk management knowledge;
- Advanced risk management knowledge applied to specific subjects, areas and phases of the value chain;
- Data mining based knowledge;
- Ability to manage data interoperability;
- Competencies in terms of human resource management;
- Transferable skills (ERA SGHRM, 2011);
- Skills from the knowledge based economy such as communication, entrepreneurship, IPR, ethics and standardization (ERA SGHRM, 2011).

To answer research questions 2 and 3, four pilot projects have been put in place and are under evaluation, such as: Post-graduate courses in the field of digitization (target: BIM manager and BIM coordinator for public and private sectors); (Adoption of) Specific PhD training paths in the field of collaborative design and management; Program of lectures in the field of digitization (target: professional development and continuous improvement)

Research in the field of BIM impact on design quality and process management (partners involved: private and public players). Meanwhile, the three main regional construction value chains have been taken under evaluation in relation to RQ 1, 2 and 3 in order to answer to question 4.

RESULTS AND LONG TERM FALLOUT

The introduction of digitization tools and methods could represent a great opportunity for improving the productivity of the construction sector. However, significant updating of skills is needed as well as ways of sharing professionals' knowledge among all the players in the construction sector.

With reference to the construction industry, the regional higher education system is characterized by:

- 3 higher regional diplomas;
- 14 graduate courses;
- 4 doctorate programs. (Figure 3)

Despite the high level of quality of the regional training offer, since 2006 the University of Ferrara has been the top University among national graduate courses in architecture (CENSIS, 2017). The research project made it possible to verify a lack of digital collaboration based knowledge issues within the courses, as mentioned before. The analysis of the regional education system also demonstrated the almost total lack of project management based knowledge even within five years courses.

In fact, there are huge numbers of courses in areas such as digital representation, virtual modeling for architectures and engineering, integrated ICT technologies for survey, 3D survey, GIS and high quality doctoral research on BIM, Big-Data management, 3D Printing tools for architecture and Artificial Intelligence tools and so on. On the other hand, the teaching of collaborative work tools and methods has not been introduced yet.

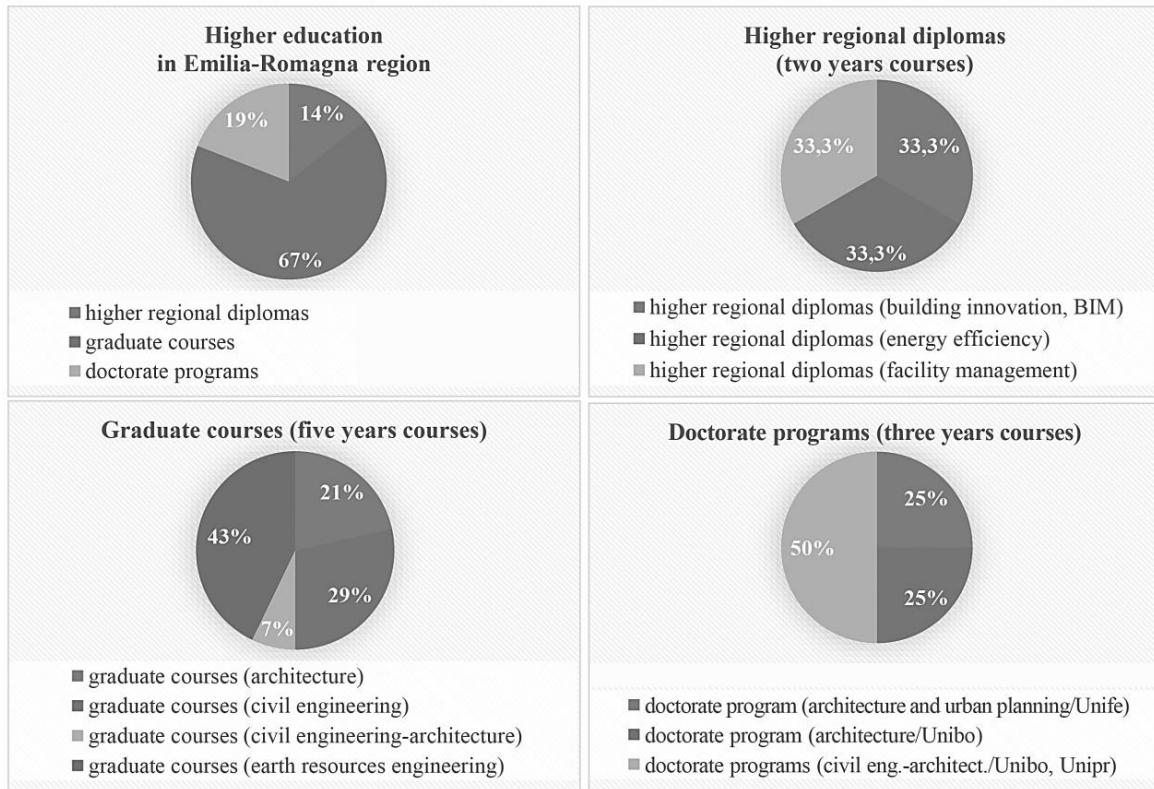


Figure 3: Emilia-Romagna higher education system.

However, with reference to the New Italian Procurement Code the following knowledge areas also need to be considered in order to achieve construction sector digitization:

- Strengthening the digitization of surveying and diagnostic processes;
- Supporting Public Procurement through data based decision-making processes;
- Developing a New Project Management approach for the construction sector (IM, Information Management and BIM, Building Information Modeling).

Furthermore, especially in the field of managerial knowledge and data-based decision making the lack of basic knowledge in master's courses is observed. This sort of difficulty can be properly managed through the introduction of project management knowledge at the beginning of five year courses. As a result, it would be possible to adopt more effective strategies, such as an inductive approach and on the job training, in post-graduate courses.

In conclusion, while the most important medium-term fallout is updating the National Qualification Framework there are other main goals to be achieved within three to five years:

1. Updating existing training courses, in specific areas, with reference to the new qualifications identified;
2. Scheduling the adoption of specific training methods (deductive training activities, on the job training etc.) to be applied in order to rapidly reach the expected target.
3. Updating bachelor, master, PhD programs (managerial knowledge, data based decision-making methods and tools, risk management, skills to enhance interactions between academia and Industry, awareness of financial tools)
4. Making post-graduate courses more effective (inductive approach, on the job training, etc.)
5. Strengthening the partnership between the public and private sector in the field of digitization in the construction industry.

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