

Building The Future: Unveiling Educational and Competence Demands for Smart and Sustainable Buildings



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Abstract

The Swedish construction sector is said to be highly traditional with a slow pace of development, e.g., in terms of adapting new technologies. However, current developments related mainly to digitalization, but also sustainability and entrepreneurship, are forcing this sector to change from almost static to highly dynamic. This paper presents results from an interview study performed with eight industry experts from various property management and/or construction companies in Sweden, all in different ways connected to research at KTH Live-In Lab. The interviews were performed to discuss and identify what engineering skills are required to operate and manage the smart and sustainable buildings of the future. The results indicate that changes in the three areas of digitalization, sustainability and entrepreneurship have different characteristics. The interviewees describe rapid changes in these areas, changes that have an unknown end goal. What is asked for in the construction industry seems unreachable. The construction sector cannot fully harvest the benefits of ongoing technological development, and academia is, in the short term, unable to help. Hence, dedicated actors solve the competence need outside traditional university educational programs.

Keywords: Smart buildings; Education; Competence; Digitalization; Sustainability; Entrepreneurship

Introduction

The Swedish construction sector, together with the production industry, had about 400,000 employees in 2018 and accounted for about 10% of Sweden's gross domestic product [1,2]. The construction sector is thus a well-integrated part of Swedish society and has been viewed as highly traditional with a relatively slow pace of development, e.g., in terms of adapting new technologies [3]. Even so, a so-called performance gap exists, which is the difference between actual and estimated performance [4,5]. Slow innovation pace, low product quality and a high-performance gap can result in increased operational costs and lower asset values [6], as well as missed environmental-related targets [7]. There are many reasons this situation occurs, such as suboptimal design, construction and operation [8] as well as weak incentive structures [9,10]. This article delves deeper into another issue, namely the competence needs in operating and managing smart and sustainable buildings.

In discussions with various stakeholders in the Swedish construction sector about the smart and sustainable buildings of

the future, there are questions about what competencies will be required, for example, in facility management, where competencies from traditionally separate educational areas must be combined [11,12]. At the same time, in discussions about the development of engineering education and society's need for future engineering skills, there is usually a difference in the perception of time between education providers (higher education institutions), on the one hand, and future employers on the other, a so-called time lag dilemma [13,14]. Higher education institutions (usually) have a long planning horizon; for example, it can take about ten years from the time a new five-year engineering programme begins to graduate the first students. From certain parts of the industry, however, there are sometimes calls for new engineering skills and new specializations, which according to these companies should be available within six months or a year, or preferably immediately [15]. This is particularly common in rapidly changing industries, such as the IT industry [16]. Something that is also receiving greater attention is the fact that many companies in the facility management sector realize that they must listen to

and meet the customer's needs to an increasing extent, i.e., they go from delivering a product, a number of square or cubic meters with a certain predetermined function, etc., to becoming a service provider, with all that it entails, such as increased flexibility [17]. This follows a trend that most industries, including manufacturing industries, have already undergone [18]. To conclude, it is stated that new skill sets are required to harvest the benefits of digitalization and interconnectedness between traditional stand-alone systems [19], as well as produce buildings that deliver services in line with current societal needs and sustainability goals [20].

The construction sector is a well-integrated part of Swedish society and has been viewed as highly traditional [3]. However, current developments related to mainly digitalization, but also sustainability and entrepreneurship, move this sector from almost static to highly dynamic. New skill sets are required to harvest the benefits of digitalization and interconnectedness between traditional stand-alone systems [19], as well as produce buildings delivering services in line with current societal needs and sustainability goals [20]. This study focuses on the universities' role for future engineering skills, using the case of the Royal Institute of Technology KTH in Stockholm. Specifically, the study investigates the skill sets required to harvest benefits related to smart and sustainable buildings. It also examines the ongoing process of change in the property management and/or construction sector, with an emphasis on sustainability, digitalization and entrepreneurship. The research question for the study concerns what skill sets the facility management industry in Sweden needs to manage the digitalized and sustainable buildings of the future. An underlying research question thus addresses how digitalization and sustainability, and the innovative capabilities within the sector, are connected. The results indicate that the changes in the three areas of digitalization, sustainability and entrepreneurship have different characteristics. The interviewees describe rapid changes in all these areas; however, these are changes that have an unknown end goal. What is asked for in the construction industry seems unreachable. The construction sector cannot fully harvest the benefits of ongoing technological development, and academia is so far, in the short term, unable to help. Hence, dedicated actors solve the competence need outside of traditional university educational programs. The structure of the paper is as follows. In Section 2 we set out the research approach and method, while Section 3 presents the results and analysis. Finally, in Section 4, we offer some concluding comments.

Methods

As the research question for this study is relatively broad but also concerns concepts that are commonly used in many narratives in society today, we wanted to be sure that we and the object of study (the property management sector) have the same understanding of these concepts. The results of this study are thus based on qualitative interviews. Eight semi-structured interviews with representatives of Swedish companies in the

construction sector (with an emphasis on property management) were conducted during winter/spring 2021. The companies were selected due to their proximity to KTH Live-In Lab, and in many cases, they had participated in one of its many research projects. KTH Live-In Lab is a research center and living laboratory at KTH Royal Institute of Technology with the aim of accelerating innovation in the built environment (KTH Live-In Lab, 2022). The activities within KTH Live-In Lab have so far focused on research and innovation, but there has been a lack of knowledge about the industry's skills needs and how this is matched with current supply, for example, in the form of engineering courses at KTH Royal Institute of Technology (KTH) and lifelong learning courses. The interviews lasted between 40 and 85 minutes and were transcribed verbatim and analyzed thematically [21]. The interviewees all have leading positions in their respective companies, e.g., as the head of operations, head of IT, head of innovation and sustainable development or property management; these can thus be labelled as elite interviews [22].

A significant part of the interviews deal with issues concerning how the interviewees (and the companies they represent) interpret the concepts of digitalization and sustainability. An early insight into the planning of this study was that both these concepts can mean many different things depending on whom you talk to. The two terms are also very commonly used in today's general debate, and they sometimes seem to include a bit of each. It was therefore important to allow the interviewees to interpret the concepts themselves. The companies' views on the connection between, on the one hand, digitalization and sustainability and, on the other, the companies' own innovative power and organization, were also discussed. This then led to questions about the possible impact on companies' skills needs because of increased focus on digitalization and sustainability. Different types of both technical and other skills were discussed here, as well as how companies plan their skills supply in these areas. Finally, several questions were asked about the educational system's ability to match the skills needs, both in the form of newly graduated staff and courses or course modules for already employed staff. The small selection of interviewees means that the results of the study cannot give any far-reaching general conclusions. The great consistency in the answers, however, provides indications of a similar approach to several questions.

Results

This section has been divided into themes such as digitalization, sustainability, innovation/entrepreneurship/intrapreneurship, competence needs/lifelong learning and finally the impact that all this can, or should, have on engineering education. The quotes in the text are translated by the author and deliberately anonymized.

Digitalization

One of the two major areas in this study is digitalization, and the interviewees were asked very open questions about what it means for the company they represent. The answers reflect the

multifaceted meaning of digitalization - there are very many, and often widely differing, things that can be accommodated within the concept. One common theme for all companies is that digitalization is said to be an enabler, apparently an enabler for a variety of things. One side of this concerns data management, i.e., measuring, collecting and, not least, processing and sharing data. The technical side of digitalization can also be found in this discussion, i.e., the automation of various processes, the measurement and management of daily operations, optimizing and interconnecting various systems, control systems technology, etc. In this context, almost all companies mention the measurement and control of temperature and air quality as examples of application areas. What is new for the industry is obviously the large amount of data that can be collected and processed, as well as the opportunity to share this data with other users within or outside a company. In practice, this is said to be an opportunity to share knowledge to create and develop new values for companies. "So, it is important to use digitalization in the right way to create new opportunities, and do things in a different way."

The second thing that emerges in the discussion about digitalization as an enabler is the fact that it can create greater customer value. Several companies point to the internal transformation that takes place when you go from being a product supplier to becoming a service provider. The customers' needs then come into focus in a completely different way, and the internal demands for flexibility increase. What is happening in the industry is like a huge disruption when it comes to flexibility. In the past, we delivered square meters of concrete, you could say. Now there is a huge focus on delivery flexibility where the customer can scale up and scale down in a very short time. And that you buy significantly more services than before. So that we deliver, so to speak, complete workplaces, complete shops, complete restaurants, where we can ... you do not have to commit to 5 years, you can leave in a month, or maybe a day. It's a huge change. In this context, several companies express that the public construction sector has much to learn from the engineering industry and their work with efficiency, with an increased focus on customers' needs and the service of their products. With inspiration from the manufacturing industry, more visionary thoughts were also expressed:

"In the slightly longer term, the 3D printer will probably change the construction process. Why carry ventilation ducts that only consist of air - what if you could print and manufacture them on site with a 3D printer instead?"

An important part of digitalization for the companies in the study is streamlining and automating their own administration and financial management. For example, one company in the study highlights its completely paperless rental process. The customers (mostly students) never have to meet the company's representative irl for contract writing, etc. In addition to a perceived increase in customer value, internal administration is also reduced; there is, for instance, no need for the manual

handling and storage of contracts. And I mean, we got thousands of documents every year. All that is gone, and we do not touch that type of paper. At that time, each customer signed two key receipts, of which the customer got one and we got one, and then it would go into folders and when the customer moved, you would take it out and tear it and everything. All that stuff is gone. There are no more printed bills or anything, everything is digital. And that creates a better work situation for our employees and higher customer value. This company also mentions that it has been much easier to implement this type of digitalization within the administration and service process than digitize the property itself. One step that several companies mention as a challenge, but which is apparently very high on the agenda, is acquiring a system with well-functioning digital keys. For the company in the example above, which deals with student housing, the cost still weighs heavily on both investment and operation, making the transition to a digital key system thus far unsustainable. The example also shows the previously described long time scale in the entire industry.

Sustainability

Sustainability is obviously in focus for all companies today, including for the companies in this study. But sustainability, just like digitalization, can mean different things in different contexts, and the companies may have made different advances in both framing and realizing the strategies. Therefore, several questions were asked about how companies view sustainability issues and what their corresponding focus is. "Sustainability is about what imprint we have in our process, both in administration and in projects. And, in development and innovation." Working with the environmental and economic parts of sustainable development seems to be quite uncomplicated for the companies in the study. A more efficient material flow, smarter material selection, lower energy consumption, etc., often also give economically positive results, which in turn motivates and provides an opportunity to intensify that work. One example is a company in the study that about 10 years ago set a goal to halve energy consumption in its properties, something it managed to achieve in about 5-6 years. The connection between sustainability goals and digitalization becomes clear here: now that the goal is to halve energy consumption again, digitalization is not only an enabler but also a necessity in achieving this new goal.

Several companies argued for the need to see a property from a whole life cycle perspective. There is an awareness that the real estate industry, especially the construction process, has a negative climate impact, but today there may be excessive focus on streamlining resources in the construction phase, resulting in a smaller climate impact at that point of development. In the long run, for example, it may be worth choosing a slightly more "climate-expensive" material during the construction phase if the operation and/or service life means there will be a lower overall climate impact. Hence, some interviewees mention that a system perspective on, for example, material and component

selection is important. "We do not want to be forced to refurbish an entire bathroom because one component is bad when 20 other components could last another 20 years."

The social aspect of sustainability is not, or at least has not been, as much in focus in the general debate, according to some companies in the study. The companies that mention this discuss the importance of people having a place where they can afford the rent or want to work; they see the building as part of the urban environment, a place where people live, meet, work, shop, etc. For several of the companies in the study, the social aspects are something that have been close to their hearts for a very long time, longer than the environmental and climate aspects, although they have not received the same attention, especially not in discussions about sustainability. Traditionally, issues of energy, waste management and material selection have received greater attention, even internally within companies. However, several of the companies note their historically strong tradition in the social aspects of sustainability, i.e., their focus on people, health, indoor environment, the footprint they make and how others perceive them. An extra challenge is the company's responsibility regarding, for example, contractors who are hired for various assignments. One company in the study mentions internal work with their own sustainability indices in different categories, where one category requires contractors to work with, e.g., gender equality. Another way is to ensure a climate-neutral energy supply, e.g., by being a partner in a wind power company (as mentioned by one company) or by investing in solar panels during renovation and rebuilding.

Innovation/entrepreneurship/intrapreneurship

The ability to advance in issues related to sustainability and digitalization is said to be related to the innovative power within companies. In this study, the questions have addressed the companies' own ability and strategy for innovations, also referred to as intrapreneurship. These questions involve the extent to which this inner power of innovation is encouraged, whether it is organic or strategic, etc. In short, what opportunities and obstacles do companies have in renewing their operations? The answers testify that the companies have advanced differently, i.e., it would not be accurate to say there is an innovation culture in every company. On the other hand, there is a general awareness that the company's internal innovation power is crucial for achieving development within digitalization and sustainability.

"For us, it's about creating this, how to say it, space to explore what our next horizon is. And to also inspire and call for development in general in the company and spread some innovation culture." Many interviewees see innovation as a management issue, and an innovation strategy has been developed that will clarify, guide, and inspire. Hopefully, this will promote and change the internal culture of innovation in a positive direction. Three quotes that illustrate this are the following: "We have deliberately created a space where we say that we will not

hand out speeding fines, but we will hand out parking fines. And that's our way of saying it's okay to fail." "So, it's a basic premise in intrapreneurship to talk about ... not to complicate things but talk about opportunity costs and talk about responsibility." "And intrapreneurship, more precisely in innovation, is something I have worked quite a lot on by creating conditions for people who want to work with it. Above all, to have the opportunity to do so in the digital arena, even though they are in a mini-role." These quotes lead to questions about how one's own organization can promote or inhibit further development in these areas.

Organization

As already mentioned, for several companies, digitalization is about collecting and using data in new ways. They may have advanced differently in the process of collecting data, but common to the companies is that they realize that the use of data will require new ways of working and combining skills. A few companies in the study have made it clear in their own organization that digitalization is more than just ICT issues, and that ICT issues are more than mere hardware and software. Some of the ICT issues therefore end up in an operations department, while others are seen as strategic and hence organized together with, for example, sustainability and business development. In several respects, there is no major difference between operating and maintaining a server or a fan. This also means that these ICT costs can be equated with other operating costs that must be streamlined and contribute to the company's profit.

And if you see these ICT issues from an operational perspective, then you do not need to talk about costs, but then you talk about alternatives. And you can show what opportunities you can do and make completely different progress. In this way we have accelerated that work and got a completely different way of thinking.

Other ICT issues are then merged with strategic management issues, together with, for example, sustainability issues and business development. "It is no coincidence that we have combined our focus on sustainability, business development and digitalization in the same team." There may be different strategies for succeeding with change work. Examples that have emerged in the interviews concern both strengthening and developing their own organization, but also adjusting and selling or outsourcing other parts. A general picture, however, is that those companies that have come a little further have strengthened and upgraded their procurement organization. There is an awareness that the competence needed does not exist internally, at least not sufficiently, and/or that it will be lacking for those services that will be in demand.

Changed need for competence.

The changed way of working with digitalization leads to an altered need for skills in companies. How far the companies in this study have come in identifying the skills needed, and

attending them, differs. In general, there are different ways of filling an identified competence need or gap; this partly depends on whether the company has a pronounced competence strategy. Common alternatives for filling a competence need are first looking at the internal possibilities, i.e., skills development, new working methods and reorganizing work. Only after this is attention directed outside the organization; in such cases, external opportunities to fill a competence need can entail employing consultants, short term or long term, or recruiting new staff. The long-term and extensive utilization of consultants can be regarded as outsourcing a function and/or area of expertise. Factors that influence this strategy are, for example, the labor market situation, actual knowledge on the scope of work for a certain position and the company's policy in these matters (Gustafsson & Karlsson, 1998).

Although this study is limited, all the options listed above have been mentioned, to a various degree, in the interviews. What applies to all companies in the study is that they see a changed need for skills but that there are many uncertainties, i.e., there are several factors that affect both the level of change and its speed.

"But what I think, is that we will see a change in how... what it means to work in the real estate industry. There are job descriptions and job titles today that will not be valid in 5-10 years." What competencies are the companies referring to? Of course, there is a focus on different technical competencies, but at the same time, several interviewees mention an increased need for both business and social science competencies. A key competence, and perhaps something new, is the need for combinations of competencies and subject areas that arise from the increased ability to collect, save, combine and analyze data from real estate. This is said to apply to operating data in the form of temperatures, air flows, energy consumption, etc., but also data in the form of entrances and exits, elevator use, utilization of laundry and dishwashing equipment, etc. The knowledge and ability to analyze the amounts of data generated is a future key competence for several of the companies. This is in line with the statements made by multiple companies regarding digitalization as an enabler, both for increased customer value and an increased sustainability mindset. For most of the companies, this competence is not available today, at least not to a sufficient extent. In some cases, it depends on the fact that the direction and scope of these new positions have not yet been fully established or clarified; there is simply no experience to lean on. The complexity of these new issues is also considerable; there are many areas of knowledge that must be combined in new ways. No matter how far digitalization and sustainability work has come, the question of how to secure the skills needed is high on the agenda.

It should be noted that most staff that companies today use in their operating activities have an educational background at the upper secondary or polytechnic level. This may continue to be the

case, even if some companies mention engineers at the bachelor's level as suitable for a certain type of operational service. However, several companies in the study are unsure whether they will employ their own operating staff in the future. This can be seen as another way to change the organization to meet a changed need for skills. It can also be viewed as a sign that they are taking a step away from the property as a technical and physical product that you manage and seeing it rather as the surface as something that must be packaged and delivered as a service that increases the customer's benefit. This is accordingly where the big changes will take place in terms of competence - all companies in the study say that this is a big challenge for their company, as well as the industry. "But this is exactly it, when you start to package space as a service, actually service, it is a sericitization, then we need new skills to be able to deliver on this new demand."

Some other companies in the study, however, say that their own operating personnel belong to the core business and will continue to do so. There are other staff categories that will develop and drive digitalization, for example, when it comes to asking the right questions concerning the large and complex amount of data that is generated, and analyzing and understanding the answers, not least in transferring this to increased customer value and thus better business for the company. Regardless of how the companies formulate new or changed competence needs, there is, as already mentioned, always a basic prerequisite of technical know-how and an understanding of the property as a technical system. "I firmly believe, to continue on what we talked about earlier, that we can talk about digitalization, we can talk about this whole part, but if you do not have a technical depth and know real estate, then you are probably smoked." Many companies mention the need for greater systems thinking. Technology areas that could previously be managed well in isolation will now be combined with other technology areas, adding further areas of competence such as business knowledge, customer relations, social sciences. "If we focus on technology a bit, then you traditionally have skilled people in both energy and heating and ventilation and stuff, but a challenge when it comes to smarter systems in each area is to get them to mesh together in the entire property system." As already mentioned, several companies have strengthened their procurement organization, and some have already introduced new types of services and job descriptions for this purpose. These are key positions that, in addition to technical know-how, also need to master several of the areas described earlier, i.e., sustainability issues, business, customer relations, etc. Common to this type of position is that it is very difficult to make a general profile description. This is due to, among other things, the fact that the companies have developed these new roles themselves.

Impact on engineering education

The interviewees generally have very few connections to KTH's (or other universities') educational programs. There are

examples of guest lectures, master theses, participation in labor market days, etc., but all interviewees say that they have no contact with the program management or equivalent that enables participation in and influence over educational programs. In fact, several people explicitly say that they do not have the resources or detailed knowledge about educational programs to do this. Some even say that they should not have such a role. Below is an example of such a view: "But in the end, KTH is a university with an academic mission. Which I absolutely think should be protected, because somewhere it should ... If not, you would have started a private technical education and said like this is tailored to our specific needs."

There is an insight here that tomorrow's employees will not only have a background in university studies, although they will probably have a basic degree from a university. As the quote above shows, basic technical competence is a fundamental requirement. Complementary knowledge and skills can, however, be provided from many different sources, perhaps in the form of courses at universities, but also from other less formal sources and experience from previous assignments. And the development that [my colleague] now leads and the technologies that we use, you can't find that at the universities. They are 10 years back. Ok, they learn technical stuff, etc., but the things we discuss right now do not yet exist in universities. So, we probably have to make sure that competence exists anyway, and people we hire and develop can come from other career paths. With all this said, education at the university level has an important role to play according to the companies in this study, regardless of the educational subject, as it trains and prepares young people for lifelong learning, i.e., to learn how to learn:

The second thing that I think is a very important part of university studies is to learn how to learn. You learned how to learn things quickly. And there is a pretty big difference between people who have ... I think you notice those who have studied at a university compared to those who have not. It is much easier to absorb and understand more complex things and be able to draw conclusions or learn new things. At the end of the interviews, the discussions were about competence development and lifelong learning. Companies have a consistent view that all employees need to both replenish knowledge, and in some cases, also change career paths during their working life. The quote above reflects an attitude that, so to speak, an engineering degree is not enough, for example, it needs to be supplemented later in life. This is perhaps especially true for the competencies that have been discussed the most in the interviews, i.e., digitalization, sustainability and innovation. For example, there is no educational program at KTH that combines these skills with, e.g., real estate technology. All in all, this contributes to the need for lifelong learning.

Today, competence needs are solved in different ways, often by buying courses from non-universities or through in-house training. In many cases, not least in the IT area, individuals take

initiatives for their competence development by themselves and often find courses or course modules online. The companies in the study also discussed what role KTH can play in fulfilling the need for lifelong learning for their companies. All interviewees believe that KTH has an extremely strong brand and that if there was a range of competitive courses, it is likely that companies would demand them. A little more specifically, KTH Live-In Lab is seen as a good platform for such operations. Nevertheless, just as for basic education, companies do not know how to influence the range of educational programs in this area.

Analysis

This study has focused on how a selection of companies define and connect digitalization, sustainability and entrepreneurship/innovation and how this in turn alters their need for engineering competence. All the companies are set in the construction industry with an emphasis on facility management. In short, the research question concerns what engineering skills are required to operate and manage the smart and sustainable buildings of the future. The results indicate that the changes in the three areas of digitalization, sustainability and entrepreneurship have different characteristics. Digitalization can be partly summarized as a rapid technological development where the possibilities of information technology are utilized to a greater extent, so far mostly related to rather low hanging fruits such as measure and share. Within the concept of sustainability, the connection between the environmental and economic aspects is, due to digitalization and possibilities to measure, easy for companies to detect, define and use to push sustainability issues forward. The social aspect falls a little outside of this, but for several of the companies, it is still a core issue. When it comes to entrepreneurship/intrapreneurship, this study provides many examples, one area being the opportunities that digitalization provides in several areas, not least in business. Another example is how the increased focus on sustainability issues drives new business models. In addition, when companies increasingly see the property as a service and not just a product, this creates new conditions for the companies, which almost forces them to increase their innovative power.

Altogether, this leads to the need for both change in the organization and new competence. The level of competence in the companies is increasing and expected to continue to increase. With technical know-how as a base, university-educated engineers will be an important source for new competence. However, the companies in the study have few or no entrances into higher education that allow them to influence the supply of engineers. Seen from a university perspective (in this case KTH Royal Institute of Technology), the three main subjects of this study (digitalization, sustainability and entrepreneurship) are also focus areas. Entrepreneurship in different forms has been woven into KTH's educations over the past 20+ years, and according to many teachers at KTH, the students' attitudes towards starting their own companies compared to, for example, starting research

has changed fundamentally in favor of entrepreneurship. Both sustainability and digitalization have received an increased focus on all levels at KTH, and this includes the curriculum design of engineering programs. One way that this is manifested is that both areas now have their own vice president, which, of course, contributes to the development in each area.

On the other hand, a bigger challenge for KTH is to develop new educational programs that are in line with the rapid developments in different sectors, including the construction sector. The challenge thus lies with developing educational programs that combine different areas of technology, and/or open for increased flexibility and rapid mobility in the range of educational programs and courses. The challenge of combining different areas of technology probably stems, at least partly, from KTH's organization; an educational program with a combination of, for example, construction technology, computer technology and business skills must be shared between several schools at KTH, and according to internal sources, there could be a problem with the "ownership" of such a program. In short, it is difficult to develop interdisciplinary training programs. The challenge of long-life cycles for educational programs and slow development has been defended for generations as a good mechanism that gives students (and educational planning) security and predictability. Given the rapid changes that are taking place in society at large, not least in terms of competence needs, one can today question this conservative force. This is perhaps most evident in the difficulty of developing and packaging courses and training for professionals. It remains to be seen if the rapid digitalization in the field of education that took place during the pandemic has provided a different and more flexible view of these issues as well.

It is also possible to add to this a discussion about the university's role as an educational institution and how the boundary for the university is stretched as it becomes increasingly exposed to competition. It is, e.g., not uncommon for newly graduated engineers to "upskill" with polytechnic education (higher vocational education or in Swedish: Yrkes högskolan). There are also educational companies (e.g., AW Academy, Craft Academy) that specialize in short, but intensive, tailored training in specific areas with experienced shortages, usually in the IT area. In both cases, it is reported that it is not uncommon for university teachers to contribute with teaching capacity, and the technology height is in many cases confusingly equal to the university level.

Concluding Discussion

This study examined an ongoing process of change in the construction sector, with an emphasis on facility and property management. The interviewees describe rapid changes in areas such as digitalization, sustainability and entrepreneurship, changes that have an unknown end goal. Given that this industry is traditionally characterized by a relatively slow pace of development, what is happening now is revolutionary. The results indicate that the changes in the three areas of digitalization,

sustainability and entrepreneurship have different characteristics; however, these are all in one way or another connected to sensors and data. The interviewees describe rapid changes in all three areas, but so far there is no consensus concerning where these changes will lead. What is asked for in the construction industry seems for the moment to be unreachable. The problem lies not with the technology itself, but rather with the organization. Innovation and bottom-up approaches related to new technologies in single construction projects risk failing due to the organization not being aligned with technological advancement. Furthermore, the process is hampered by an industry sector that cannot clarify what competences are needed and an educational sector that does not know what to deliver/offer. The construction sector cannot fully harvest the benefits of ongoing technological development, and academia is so far, at least in the short term, unable to provide assistance. However, dedicated actors manage to solve the competence need outside of traditional university educational programs.

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