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DISCUS PROJECT

Digital Transformation in the Construction Sector:
challenges and opportunities

Country Case Studies

Report – Spain

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**DIGITIZATION IN THE CONSTRUCTION SECTOR
IN SPAIN**

INTRODUCTION

The DISCUS project seeks to know how technological innovations are currently being incorporated in the construction sector in Spain and deepen the analysis of the role of labour relations in this ongoing transformation.

The third research phase of the project is focused on the analysis of companies' experiences that have digitally transformed their production and work processes. Specifically, the impact of technologies is analysed in various areas: the value chain, employment and working conditions. Regarding labour relations, the role of social agents at the company level, collective bargaining and the issues addressed by them are examined. As a result of this analysis, factors that drive or slow down digitization processes in the company could be identified. Finally, these experiences allow us to know how companies have addressed the COVID-19 pandemic and its relevance as a driver of digital transformations in companies.

The methodology of cases studies offers many possibilities for exploratory analysis or initial objects of study. Where there is little quantitative, detailed and disaggregated information, the analysis of experiences brings us qualitative information on the reality of the companies, as well as the identification of the most relevant elements of the processes analyzed. However, it also entails a series of restrictions that should be noted. Conclusions cannot be extrapolated beyond the close context of the companies, their productive organization, as well as the agents that participate in them.

In order to cover the sectoral reality, the selection of experiences has been carried out according to the following criteria: a) various technological innovations (BIM, apps and prefabrication / industrialization); b) business size (large, SME); c) type of activity (construction on site, off-site) d) type of projects (public works, private building, etc).

Table 1. Analyzed cases, by selection criteria

		Case A	Case B	Case C
Technological innovation	BIM	X	X	X
	Application	X	X	X
	Prefabrication / industrialization		X	X
Business size	Big	X		X
	SMEs		X	
Type of activity	Construction "in site"	X	X	X
	Construction "off site"		X	X
Type of project	Civil works/public works	X		X
	Private Building		X	X

Source: own elaboration.

In any case, it is worth noting the difficulty of framing experiences into typologies. It is common for companies that decide to transform their processes and products based on technologies do so from various fields. This happens, for example, when they incorporate BIM methodologies, which also involves the use of applications on site or prefabrication. The interrelation between the technological innovations analyzed brings certain complexity when it comes to analyzing the specific impact of each of them. The transformation of construction processes of the selected companies clearly highlights this issue.

In the same way, it is necessary to point out the difficulty of evaluating certain aspects in detail, such as, for example, the impact of technological innovations on employment and working conditions of subcontractors. Due to the structure of the value chain, with many companies and professional profiles, it has not been possible to address the reality of subcontractors entirely. Some information about them has been obtained through the selected companies. An issue that has to be taken into account in the analysis of the sectors' value chain.

The fieldwork has been based on 12 semi-structured interviews, covering the following profiles: a) company management / human resources, b) worker representative/s; c) worker/s. In some of the companies, specific interviews have also been conducted with those responsible for R&D, applications or BIM methodology. As a validation mechanism of the project, the content of each case study has been verified by some of the interviewers of the companies.

Table 2. Number of interviews by case and profile

	Case A	Case B	Case C
Company management / HR /R&D / BIM	2	2	1
Workers representative	1	1	1
Worker	2	1	1
TOTAL	5	4	3

Source: own elaboration.

These experiences are presented anonymously, following the structure of the project. Thus, in a preliminary section, main characteristics of the company are presented. The second section addresses main digital innovations and company motivations. The third section analyses the impact of digital change on the productive and working organization, with specific interest on its effects on the value chain. The fourth section covers the impact on employment (creation, destruction or transformation) and the analysis of the professional profiles linked to digital change. The fifth section examines the impact on working conditions, in a variety of items. The sixth section allows us to identify factors of digital change, in terms of drivers and obstacles. The seventh section analyses the role of social dialogue on digital transformation, considering the collective bargaining at company level. The eighth section addresses the responses made during the covid-19 pandemic and the role of social agents. The last section gathers main conclusions derived from the analysis carried out.

Finally, we would like to thank all the companies and people who have participated in the study, their willingness and collaboration. Without them, this work would not have been possible.

Case A: Big company with presence in different activities

1. Main characteristics of the company

Company A is a Spanish multinational business group that is listed on the stock market. Its business is based on the construction, development and operation of infrastructures and civil buildings. It has a presence in more than 40 countries, on five continents. It has almost 40 thousand workers globally and its gross operating profit (earnings before interest, taxes, depreciation, and amortization - EBITDA-) is 1,356 million Euros in the year 2019. In Spain, the company has a total of 20,870 workers in 2019¹. The company has three main divisions: energy, infrastructure and other businesses. The construction division concentrates the majority of the group's turnover (40%), as well as the workforce (28%).

Table 3. Main activities of the company A

- **Energy** includes the activities of promotion, construction, operation, and maintenance of renewable energy plants, as well as the sale of the energy produced.
- **Infrastructures:** includes the areas of construction, concessions, water and services.
 - **Construction** incorporates the infrastructure construction activity.
 - Concessions, includes the activities of exploitation of transport concessions and hospitals.
 - **Water** includes the construction activities of water treatment plants, as well as the integral water cycle management operations (capture, purification, purification and return to the environment).
 - **Urban mobility** includes vehicle rental, facility services, handling, waste treatment services or logistics services, among others.
- **Other businesses:** includes activities related to financial asset management, stock brokerage, wine production, real estate, among others.

Source: Own elaboration based on the company's website.

The workforce is mainly concentrated in *infrastructures* (93%), followed by *energy* (4%) and *other businesses* (3%). Women represent 30% of the workforce, a percentage that is higher in *concessions* (54%) and lower in *construction* (17%). By type of contract, 29% of the workforce has temporary contracts, being higher in *construction* (35%) and lower in *energy* (3%). By type of professional category, most are operators (74%), followed by technicians (16%), directors and managers (6%), supports (3%) and other categories (1%)².

2. Digitization and innovations

Technologies are incorporated in most of its productive activities of the company A, showing a relevant level of innovation. Regarding certain technologies, interviewers mention that the company presents a similar level of innovation to other European countries, while with respect to others it is somewhat later.

According to them, all innovations have a decisive impact on the environment and energy, making the construction process more efficient and sustainable. Thus, it is argued that BIM methodology improves construction in terms of sustainability, providing improvements in the process (reduces duplications and expenses, provides data on the process and its compliance, as well as data for the study of the carbon footprint, in other aspects).

¹ Annual report of the company, 2019.

² *ibid.*

Main technological innovations

Broadly speaking, the company has incorporated the following innovations:

- a) *Building Information Modelling*, applied mainly in construction projects, both in the areas of construction and civil works.
- b) *Applications and tools*. They cover the digitization of paper or the lack of physical presence “on site” (such as scanning or drones), avoiding fewer people in risk areas and speeding up data collection. Virtual reality technologies are also included, as well as the use of robots (automation), although they are still in an exploratory phase.
- c) *Materials* (concrete for extreme situations and new composite materials, such as polymers reinforced with carbon fiber).
- d) *Management tools* for environmental and social information. Within the infrastructure section in the construction area, an environmental reporting tool has been created and it has been extended to the social sphere (with an internal website for data management).

These innovations are closely linked to the circular economy, in the use of waste from other industries (such as, levelling of soils and associated activities). According to the interviewers, their incorporation has meant an advance with respect to the information that the company has about the construction process. With them, many parameters of the building process can be measured, managing and optimizing resources, both in terms of costs and ecological outputs. For them, the quality of the data that is generated is a central element, which has to be linked to the use of technologies in other sectors (such as the use of blockchain for the information or for the traceability of plans).

Innovation within the company

The overall investment of the company in R&D + is valued at 230 million Euros in 2019 (225 million in 2018). Construction is the activity of the company in which more innovation projects are being developed, 47 projects out of a total of 79 projects developed in 2019. The company shows a high innovative intensity, which represents 17% compared to EBITDA (18% in 2018).

The company has an R&D department that primarily supports mainly construction and water activities. It pursues several objectives, having impact in processes, safety, energy efficiency and sustainability (reduction of costs and times, increased employee safety, less environmental impact, etc.). This department is divided into four major research areas: a) materials (concreting and new materials), b) construction processes (infrastructures, roads and soils, railways and tunnels, maritime and airports), c) building and d) digital innovation, and transversal to all activities. Likewise, it supports the entire construction process, addressing the value chain through the departments or companies that are part of the business group (from engineering and design to construction, maintenance or the financing of the projects).

Innovation is delimited at different levels. At the first level, there are technological hubs, which promote the creation of medium and long term innovations (blockchain, virtual reality, expert systems, etc.). At a second level, there are innovation centers, which are responsible for innovation in each of the business areas (water, energy, construction). And thirdly, there are digital transformation departments, whose function is focused on transferring technology to projects, with the aim of contrasting their practical application (barriers and opportunities for innovations). In general, innovations are tested through pilot projects and then they are extended to other projects, activities and business areas.

Emergence and application of BIM in the company

The use of the BIM methodology began between 2007 and 2008, in the Construction R&D center, where a specific BIM department was set up with the aim of supporting the entire company. The

initial group was based on professional profiles of ICT and architecture. It started with a pilot project (an airport terminal), which mixed traditional construction and BIM methodology, in order to assess its practical application. The company's digital transformation plan incorporated this type of methodology due to the demands of some projects and work teams, but mainly due to the influence of the projects that the company had abroad.

Over time, this methodology has spread to other departments, as well as to all projects. The company decided to extend it from the construction area to the rest of the business areas (it began to be used in construction and then went on to civil works). Instead of centralizing knowledge, in a first phase, the implementation of this methodology was articulated through a diversified structure, with personnel and teams that were trained for it, depending on the different business areas. In a second phase, it is being considered to extend this knowledge structure, making it permeable to all areas and departments.

Its incorporation has been influenced by several factors. On the one hand, the impulse of public clients and the demands of specific projects, incorporating it at the beginning of the construction process. In this sense, it stands out that this methodology is a European requirement, present in a large part of the projects carried out by the company in Europe. On the other hand, it has been pushed by construction managers, who asked for specific demands in their work. A process "from bottom to top" that has not been interrupted by the intermediate structures of the company. Finally, due to the impulse of the certification of the construction processes, which the company assumes as a priority, searching for certification in ISO (19650) for BIM methodology.

3. Impact on the organization of production and work

The impact of technological innovations in this company would affect the entire value chain. The company pursues its incorporation to a greater number of projects. This is done through the concurrence of different departments (and companies of the group): engineering (design), construction, maintenance and financing (concessionaire). The R&D department supports all departments (and companies of the group) in the digitization process. Currently, the company is seen in a transition phase, combining digital and traditional construction.

Processes and tasks

Construction processes have been automatized with the BIM methodology, reordering of activities on site and reducing time and resources allocated. To do this, various technological innovations (drones, apps, etc.) has been used to obtain information on the construction process.

A potential impact of this methodology is estimated in all processes, but it is recognized that its practical incidence is uneven in the parts of the value chain: there is a greater incidence in design, production, quality, and somewhat less in maintenance and purchases. Its application is mainly focused on planning and the improvement of certain traditional construction tasks. By business area, it is having a decisive impact in the area of materials and composites, but also in construction, generating more controlled and safe spaces.

In relation to processes, the incorporation of technological innovations has allowed:

- To improve the coordination and the sequence of work. In the planning phase, inefficiencies can be seen and be reduced.
- To lighten work flows in the construction phase of the work, but with the increase of time and resources required in bidding and design phases.

- To develop processes and tasks in parallel, with a shared model, against the sequential way of the traditional construction.
- To order and to provide transparency to the construction process and to improve the way in which information about it is obtained. Information comes almost in real time, facilitating decision-making on the project and improving execution times. It allows, for example, to record the time and location of tasks and work processes.
- Modify quality measurements, making decision-making by the person in charge more agile.
- Evaluate the application of their own methodologies and applications, modifying them to the needs of the company and projects

At the same time, work processes are standardized and made more flexible. Specifically, BIM methodology enhances several changes: (a) It imposes routines that facilitate the construction process, automatization and standardization of tasks (for example, quality reviews); (b) It obliges to limit and define the processes, with the aim of making information operable; and (c) It allows flexible processes and tasks of construction project, allowing launching activities in parallel.

Relationship with subcontractors

Regarding the value chain, the incorporation of BIM methodology has modified the relationship with subcontractors. The company tries to involve the entire value chain, including subcontractors. It considers that without them its implementation would not have a real effect. Here, two factors are considered:

- The construction project, in which different issues are defined by the company (delimitation of activities, profiles, information management system, etc.). It could be defined in a broad way or remaining to subcontracts companies, in order to give them more room for manoeuvre and also make them feel comfortable with the project;
- And the type of subcontractor, defining their performance in the value chain. For example, if an auxiliary service is demanded, it may not be necessary to include them within the BIM model, although a traceability of the process is still required.

Among the potentialities, it is pointed out that the BIM methodology allows: (a) a greater interconnection of the activities carried out in the construction work, including those of subcontractors; (b) to optimize the business margins of the subcontractors, since their participation and resources allocated to the work are clarified.

On the contrary, in relation to subcontractors there are difficulties derived from two elements:

- Lack of prior participation. Subcontractors are not usually known in advance, but a few weeks before their work is produced. So it is difficult to incorporate them in the early stages of the BIM design. Here, differences by countries are identified, for example, in the Nordic countries BIM is more implemented along subcontractors than in Arab countries.
- Lack of knowledge of the whole process. Delimitating activities requires a management decision regarding strategy. New technologies should be considered as investment in the long term. Subcontractors may not see the return in the short term, so they may not be so interested in transforming their companies.

Different degrees of use of the BIM methodology by subcontractors are identified. If their activities are affected by new technologies, it is easier for them to incorporate BIM, because it is easier for them to find its benefits. According to the company A, subcontractors are entering little by little, but it is expected that they will increasingly adopt this methodology. Subcontractors of metallic

structures or facades are the first ones, because they obtain a lot of profit, whereas others like the plasterers still do not. Regarding size, small companies can perceive it as an expense, discouraging the use of the methodology in the short term.

In short, the participation of subcontractors is conceived as a process that is improving on a day-to-day basis. Company A is looking to incorporate subcontracted companies into the negotiation process of the project, understanding that if company A uses a BIM methodology, it will encourage subcontractors to also be interested in using it (as a tractor effect).

Project and procurement

The use of BIM methodology is largely conditioned by the type of project, as well as by the clients and promoters. Differences are identified between the projects that company A carries out outside and within Spain.

In abroad projects, contracts are used to incorporate services and activities contracting, which makes easier the participation of subcontractors in the design and project phases. This allows them to indicate their demands. Contracts are usually stricter in terms of price, but in this way are usually more flexible, more collaborative with subcontractors. The use of BIM requires that contracts and activities have to be previously defined.

In Spain, the process is different. Contracts with the designer are closed, agreeing on the scope of the project. Subsequently, a contract is made with the builder, which the BIM model can be agreed with. Companies are usually very proactive in reaching agreements, but uncertainty is always registered whether their compliance. Concerning the value chain, the company has recognised that design and promoters companies are used to participate in the early phases of the project (tender and design). However, companies dedicated to construction and maintenance are usually with the project underway.

The experience of company A allows identifying three levels in the use of BIM methodology: (a) high level of BIM requirements, when requested by the client; (b) medium level of requirements, in which it coexists with traditional practices; (c) low level of requirements from clients, but in which the company A tries to promote its use within the project.

Investment and costs

Technology implementation is highly influenced by the level of investments that companies should face. According to the company, BIM methodology has had a relevant impact on the execution deadlines of the work.

The company has analysed the cycle of processes, materials and costs. It recognises that technology implementation could be more expensive at first instance, but in the long run it leads to an improvement in the construction process (particularly in manufacturing). However, it has less impact in other areas, such as purchases. It also recognised that customers and subcontractors are not always in favour to assume the costs derived from the application of BIM methodology.

Assessment on the productive organization

Technological innovations are having a decisive impact on the productive organization of the company. They represent a qualitative leap compared to traditional construction, optimizing processes and tasks and controlling resources. In this company, traditional and new construction still coexist.

BIM methodology affects, particularly, the decision-making processes of the company (project managers), being one of the main elements of its implementation. According to the company, the person who has to make the decision has to have BIM knowledge and to manage the data of the construction process, being also able to intervene directly on it.

The interoperability of the BIM methodology is also pointed out by the company. All the agents have updated and reliable information on the construction processes, although their access could be limited by the designers. Different layers, filters of information and uses of the data can be set. Moreover, its environmental impact is mentioned. It allows reducing duplications and resources. In this respect, initial initiatives to study carbon footprint using BIM methodology have also been developed by the company.

From workers' point of view, the use of BIM methodology has brought a faster access to information, a reduction of activities and more agile processes, avoiding possible deviations from the initial project. On the negative side, they mentioned that learning time is needed to adapt to doing things differently and sometimes it has been insufficient.

4. Impact on employment

Employment dynamics

At first, the incorporation of technologies in the company, such as the introduction of BIM, involved the hiring of workers. Profiles were hired without a consolidated experience in the construction sector. According to the company, this trend was related to two issues: a) at first, it had difficulty to find people with digital skills (BIM knowledge); and b) due to the requirements of some tenders that requested these technological profiles.

Experience profiles were sought in the sector, but the volume of people needed was higher than those existing in the company at that time. This had a collateral effect within the company. People with technological profiles and little experience were sometimes seen as "strangers" in the projects, registering certain lacks of collaboration. This situation has subsequently been resolved.

The incorporation of technologies is not experienced as a process of substitution of traditional profiles for others more technological, but rather as a transformation of the traditional profiles with new skills. Training allows reducing the reluctance to change more traditional profiles, being a supporting element of this change.

According to the company, there is a lack of workers in the construction sector, which is linked to age. In this respect, it is highlighted that, after the 2008 crisis, the group of 50 years and over, has already retired and many of workers between 40 and 50 years old have moved to other sectors. So, difficulties have been registered by the company on finding certain professional profiles and on incorporating young workers.

Professional profiles: skills and roles

Training in the company has had different stages. At first, a process of internal and face-to-face training of the staff was started, through a system of external and internal trainers. Currently, a growing demand for training in digital skills is registered. This implies that specialized profiles in digital competences must combine their own activity with training activities.

To increase the scale of training, online training has been developed through the company's internal platform, with the possibility of taking specialized short-term courses for very specific profiles. Here, there are some examples of trained profiles, by areas: in the construction area (technical office, surveyors, project managers of small projects); in the engineering area (draftsmen, project managers or discipline managers, technicians and engineers).

It is highlighted that investing in training has significant returns for the company: profiles with experience in the sector and digital skills (BIM) become more productive. In order to have fruitful results on training, an accompaniment of the profile trained should be established over time. For this, a specific structure of support was created by the company, for consultations and doubts that may arise during the implementation of technologies.

5. Impact on working conditions

At first glance, the incorporation of technologies is valued positively with respect to working conditions. It is stated that they allow construction work to be increasingly sustainable, safe and stable over time. According to the company, it is estimated that they do not bring a working time increase, but a greater efficiency of working hours and project execution times.

Beyond this general assessment, the use of BIM methodology has led several impacts. According to the information provided, the following can be noted:

- **Workload-intensity.** At the beginning, a greater workload was registered in the BIM department, due to the project demands and the lack of qualified staff. Currently, the impact on workload varies by department. Technical offices have more load and need more resources. With BIM, the workflow has more loads in the initial phases and less on the construction site.
- **Working time.** An increase in the working time of technical offices is registered, while execution times and deadlines in the work are reduced.
- **Coordination-participation-hierarchy.** Trained workers on BIM have been key in the implementation. Communication between departments and workers has been improved. Subcontractors are not always included in the design phase. Some of them are reluctant to share information. Internal reluctance is also detected, derived from the entry of BIM profiles in projects (hierarchy and traditional profiles), which have been minimized by the support of the BIM department.
- **Stability-precariousness of employment.** It is estimated that if subcontractors are not incorporated into BIM, the risk of transferring pressure of deadlines and job rotation may be increased.
- **Labour mobility.** High international labour mobility is registered in the company, with abroad projects that work with BIM. As a result of this, the company has had an output of profiles and the entry of greater BIM knowledge.
- **Professional training.** Training actions have been developed, considering different levels, workflows and deadlines. Actions are divided by general training and advanced training. Support and help from the BIM department is contemplated.
- **Security and health at work.** With BIM, activities are organized and reduced on the construction site, thereby improving safety and risk prevention. Prior knowledge of works improves decision making and security.
- **Polarization.** It is estimated that not all workers use technologies, either because they do not need them or because they have not adapted to them. In the future, there may be certain differences between BIM and non-BIM profiles, as with other professional skills (having languages). It is estimated that the company will continue having projects and profiles without BIM, which will presumably be displaced in terms of working conditions.
- **Know-how.** BIM profiles will no longer want to go back to working as before. The traceability and transparency provided by this methodology represents a substantial change from traditional construction practices.

In sum, the use of BIM methodology has led an increase in the workloads of workers and technical departments, especially in the initial implementation. As the company was having more BIM projects, the workloads increased. However, over time these overloads have been reduced, mainly

due to the knowledge acquired of new work processes. In the value chain, it has been difficult to assess the impact on the working conditions of subcontracting companies.

6. Drivers and barriers of digitization

The experience of company A allows us to identify some drivers and barriers of digital change at company level. According to the information provided, the following driving elements are identified:

- **Customer demand - Contract.** Higher degree of development of the innovations is registered when they are demanded by the clients and are reflected in the contract, as starting point of design of the construction project.
- **Innovation department and investment in R&D.** The existence of a department or area with resources for the development of innovation in the company is a key factor for the company to carry out the digitization process.
- **Improvements in production processes.** To the extent that concrete results are obtained, the company is more disposed to make changes in the value chain, construction projects and business areas. The traceability gained by the access and management of information in a shared way is valued as a central point.
- **Staff: technical offices vs. on site.** BIM staff has been on the basis of the change. His motivation and requalification has been linked with a greater internal recognition in the company. On site, the implementation of BIM has relied largely on the project managers, who request working with BIM and changing the way of building.
- **Company size.** Being a big company could boost digital change. However, some elements could condition this decision (business decision, departments and personnel involved, resources and investments). The large size also provides a greater capacity to test technological innovations in projects.
- **Public administration.** The driving role of administrations and public policies is recognized, but a greater effort is required, either in the demand for public and civil works or with sector regulations.

Regarding barriers, from the experience of company A several factors are pointed out that may have a negative impact on the incorporation of technology, especially, on the implementation of BIM:

- **Contractual framework.** The use of certain technologies is influenced by the contract, which defines the participation of the different companies, as well as the tools to be used (BIM, for example). This may or may not reinforce the transparency of the construction process.
- **Internal organization.** Internally, the main barrier for the implementation of BIM is the middle staff, who sometimes have a short-term vision of the construction process.
- **Lead times-standards.** Execution times can make innovation difficult, if all parties do not agree to work with BIM. Construction must be done according to construction standards, which are sometimes not updated to innovations (processes, materials, etc.). This sometimes means increasing time frames until the standards are updated.
- **Costs.** The company recognises costs as a relevant factor for innovation, both for large and SMS companies (as is identified for subcontracting companies).
- **Business areas' participation.** In the company there are some areas more involved than others in the implementation of BIM (such as water), as well as territories (regions and countries). They use this methodology by default.
- **Size of the company.** As a large company, there is difficulty in involving departments and mobilizing people. Difficulties arising from the organization and the internal hierarchies of the company.
- **Tradition.** A certain inertia is detected in the way of working and difficulty arises when changes are introduced in processes and jobs ("this has been done like this all our lives").

- **Expectations vs. reality.** Applications may not meet initial expectations. For this reason, the company went from pilot projects to gradually extending the BIM methodology in the rest of the business areas, attending to the concrete changes in the projects.
- **Digitization without changes.** Technological incorporation at work may not entail significant changes in the construction processes. This does not happen with BIM, which modifies processes and tasks, both in planning and on site. According to the company, technologies without organizational change do not increase the productivity of the company as much as the use of BIM methodology.

7. Social dialogue and labour relations

Working conditions are regulated under various regulatory frameworks. In Spain, the main instrument is the General Collective Agreement of the Construction Sector, which covers all construction companies, including the construction area of the company A. In total, 311 collective agreements are registered in the different areas of the company. Collective bargaining coverage is greater than 99% of the workforce and the company has company committees and health and safety committees. Regarding workers' representation, there are 757 legal representatives of the workers in Spain.

Concerning digital change, the collective agreement of the energy branch of the company A has addressed the use of technologies and rights of disconnection of work. Specifically, the risks of permanent connectivity and over exposure to information are recognized, so the parties agree to respect the right to digital disconnection. The possible illicit use of computer tools is also addressed, establishing control procedures.

Table 4. Collective agreement, energy branch of the company A

Article 84. General principles.

The parties are aware of the importance that the widespread use of new technologies and knowledge have in the workplace and of the problems that may arise from their incorrect use and agree to regulate this matter under the following principles of action:

1. Group X may control the use of computer tools and technical means that it makes available to the worker, respecting their fundamental rights, especially the right to secrecy of communications and the privacy and dignity of workers. .
2. The measures adopted for the control by the employer of the use of computer systems will be proportionate to the existing risk.

Article 84 bis. Digital disconnection in the workplace.

The digital revolution, the rise of new information and communication technologies ("ICTs") and the processes of automation and globalization pose a challenge and a paradigm shift in all areas and, especially, in relations labor. The implementation of ICTs in the workplace should be beneficial and, in fact, this is evidenced by the multiple advantages it entails (e.g., increased efficiency and productivity and improved flexibility). However, a series of drawbacks have also been revealed (e.g. risk of permanent connectivity and overexposure to information) that require attention and a solution. All this has provoked an intense debate on the need to establish and regulate the right to digital disconnection, which has led to the inclusion of a specific article (article 88) in Organic Law 3/2018, of December 5, on Protection of Personal Data and guarantee of digital rights, as well as a new article 20 bis in Royal Legislative Decree 2/2015, of October 23, which approves the revised text of the Workers' Statute Law. Taking into account the above, within the framework of X's group of companies, the parties to this Agreement undertake to respect and enforce the right to digital disconnection in the workplace, seeking the greatest consensus among them, all in accordance with current legislation.

Article 85. Illegal or abusive use of computer tools and technical means and control procedure.

When there are reasonable indications of illicit or abusive use by an employee of any of the computer resources made available by the employer - access to the internet, mobile phone, email, computer, etc. - the company will carry out the appropriate checks and, if necessary, it will carry out an audit on the employee's computer or on the systems that offer the service, which will be carried out during working hours and in the presence of the employee and a representative of the workers or the appropriate union organization , in case of affiliation, if the employee wishes, with respect for the dignity and privacy of the person. In the case of verification by the company of the abusive or illicit use of computer tools and technical means by the employee, the company may carry out restrictions on the use of said tools or means, as well as the application of the planned disciplinary regime in chapter XV of this agreement.

Source: own elaboration based on the content of the collective agreement.

With respect to the construction activity, it should be noted that social agents have not negotiated issues related to the impact of digital change. Despite this, they express their interest in moving labour relations forward to digital changes' impacts, both from the business and union sides. If it is not done yet, it is because the digital transformation processes are not consolidated throughout the company or because its impact on the organization and working conditions has not demanded its regulation by collective bargaining.

8. Covid-19 impact: the role of digitization

Several organizational changes have been developed by the company A during the covid-19 pandemic. They have been positively assessed, both by the company management and workers. In Spain, except for the period of state of alarm, in which only essential activities were carried out and there were certain slowdowns in supply chains, the company has continued to carry out its activities and services.

From an organizational point of view, the following measures can be highlighted: a) organization of personnel and positions, applying various models depending on the departments (shifts and rotations, limitation of face-to-face positions, with confirmation previous, bubble groups, etc.). b) adoption of teleworking, providing computers and improving remote connections to servers; c) communication of health situations by app (positive, cold, etc.); d) changes in common spaces (e.g. dining room) and f) the increment of company's buses frequencies, among others.

To adopt them, the company has provided necessary means (computers, connection, etc.) to carry out the work. In this sense, the company has tried to ensure that new technologies do not widen existing gaps between jobs. It is recognized that salary differences may affect material home conditions. The adoption of telework has concentrated in central offices, being valued positively by the company and workers. It has also had a positive environmental impact as a result of reducing commutings.

These measures have been addressed by labour relations, with the participation of the workers' representation. In this line, both company and workers' representation have carried out joint and separate communications during the pandemic (security, distance, gels, cleaning, etc.).

Finally, according to the content of the interviews, it is highlighted that the covid19 pandemic could accelerate the digital transformations of companies. In particular, the following fields of incidence are pointed out:

- a) The promotion of prefabrication and use of BIM. It is expected that there will be changes in processes that are easier to industrialize, without radical changes in the short term. This will depend on each country and on the characteristics of the production structure;
- b) The occupational health and safety conditions, as reflected in the pilot tests for measuring distances between workers and preventing occupational risks (with cameras and artificial intelligence). There is a lot of technology that has emerged in the context of the pandemic;
- c) The extension of teleworking. Faced with the culture of face-to-face, the pandemic has reinforced remote work in an internationalized company where they had previously worked like this. This implies a change in business culture and ways of working, which have been accelerated by the effects of the pandemic.

Case B: Medium company with presence in real estate

1. Main characteristics of the company

Company B is a Spanish medium company focused on promotion and construction of buildings. It was created 32 years ago with a small size and mainly focused on building and occasionally on infrastructures. It has a societary structure and its position in the value chain is promotion of construction of buildings. Its activities are supervision of constructions that are made by other companies. Their clients are diverse in sizes and typologies. In 2019 the company has employed 96 workers and its gross operating profit is 45.8 million Euros. It is organized in 10 working areas.

Table 4. Main working areas of the company B

<ul style="list-style-type: none">● Financial and administrative● Technological processes● Research and planification● Sustainability and energy saving● Promotion and delegation● Projets● Production● Commercial and marketing● Technical assistance● Human resources
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Source: own elaboration based on the company's information.

2. Digitalization and innovations

The productive activities of company B incorporate varied technologies and show a high degree of innovation in the construction process such as automatization of tasks, off-site prefabrication or digitalization of paperwork, resulting in a reduction of environmental impacts and energy saving.

Main technological innovations

Broadly speaking, the company has incorporated the following innovations:

- a) **Own software**, based on *revit*, that allows managing BIM projects in all their phases (from the conceptualization, development and management of the project, to the production phase); It allows to know all the development of several elements week by week, how much each element is cost and which is the needed time to place it. Each element has incorporated the cost of the material and the installation activity, the time in hours of installation. This allows knowing if the installation is done in a proper time and according to the requirements, so that, in case of deviations, it is possible to change the construction solutions and construction processes.
- b) **Off-site precastings**. This process is developed by other companies and supervised by company B. It allows reducing waste and execution time, as well as having greater control of the work, reducing energy costs associated with the transport of goods.
- c) **Digital applications and tools**. In addition to its own software, the company uses various digital devices that provide information to the system: a) tablets, for site managers and b) virtual reality, used for various tasks (stakeout, positioning, interference detection, etc.).

Emergence and relevance of innovations

The company's main motivation to innovate was to get a better product at a reasonable price. To do this, they understood that they had to change the way of building and carry out important transformations, with which they could check and measure the construction process of a building at all phases.

It is pointed out that the transformation process has been a long and continuing process, with successes and errors. The transformation began 5 years ago, with the presentation of the project to the Center for Development and Industrial Technology (CDTI), which was classified as an R+D+i project, achieving the maximum rating. The project could be evaluated in all phases of the work.

The innovations introduced by the company imply an improvement in the construction processes:

- a) Productivity improvement, since there is prior knowledge of the processes and tasks of the workers on site; This allows certain jobs to be started at an earlier stage than traditional processes, reducing costs (for example, by 40% in electrical jobs);
- b) Returns derived from prefabrication, for example from facades. Even having a higher cost per m², these new techniques offer a differentiating element with respect to more traditional forms of construction (brick) and also allow the possibility of ecological certification like *passivehouse* certification.
- c) The houses built with these new techniques have lower environmental impact, both in the construction phase and in the use phase, allowing reducing energy consumption. The change in mentality of the clients and their major environmental concerns has influenced In this process of change.

The implemented system has allowed a higher control, from a very early stage, over all the construction process and project costs. It also allows monitoring during the development of the project, avoiding economic and resource deviations. Thus, the project is developed as was planned, with a continuous monitoring and controlling of the execution of the work. This new method of planned construction enables hiring all the resources associated with the project at their proper moment and sending them to the site just in the time they will be used.

3. Impact on the organization of production and work

Initially, to carry out its digital transformation process, the company had to define all the processes that existed in the company, incorporating different elements (mission, objectives, indicators and person responsible).

The purpose of this design was to delimit and reduce the number of activities carried out on site, allowing the definition of different "production lines" into which the different activities and tasks of traditional construction are integrated: for example, structure line (excavation, foundation, etc.); enveloping line (facades, roofs, etc.). Each one of these lines becomes itself in the database of a production project, collecting the different stages that must be completed in each one of them. This allows better definition of the tasks on site for internal staff (technicians and site managers) and also for external staff. It is estimated that this work would serve for its later industrialization.

At the same time, the company works with prefabricated materials from other companies. Company B has designers, architects and engineers to shape the structure and elements of the house, with the aim of reducing the number of elements (inside the precast). This seeks a lower cost and a lower number of activities and additional elements to the structure. This is a relevant element in terms of

time because it reduces waiting times for materials and allows better coordination and structuring of the execution of the work.

From its own experience, the company also points out that the digitization of construction processes brings possibilities but also it has certain limits. For example, prefabrication has made it possible to significantly reduce construction site rubble (around 40%), and also it has made it possible to reduce the number of activities and people on site. Among the limits, it was mentioned that it is not possible to digitally monitor each and every one of the activities carried out in a traditional work.

The digitization process provides very valuable information, because it allows knowing in a centralized way every single process in real time. This is the basis to plan and control the process from the beginning. In this sense, it allows to know all the deviations with respect to the initial project and to adapt them in advance.

Processes and tasks

The incorporation of technologies has implied relevant changes in the value chain. According to the company, innovations have generated new organizational structures oriented to the client, to the results, being flexible and capable of teamwork.

By business areas, the company points out that the digitization of the construction process brings new features to all of them. Specifically, the following are mentioned:

- **Commercial.** By creating new flow of information between the commercial and the project departments. It has allowed automating customer's choices in projects and their direct link between BIM projects and commercial software.
- **Administration-purchases.** By linking BIM projects with contracts with suppliers and administrative area (invoices)
- **Promotion:** By knowing generated construction costs for feasibility studies of real estate operations through BIM projects and own software developed.
- **Technical office.** By analysing the project in real-time and its deviations with the promotion project carried out previously.

Its own production management software (HUBE) is based on the concept of "management by work processes", which allows greater efficiency among all areas of the company. All the phases of the construction process (planning, organization, direction, control, etc.) are carried out through this system. With it, contacts between departments are streamlined. One area centralizes the information, which can be accessible for the rest of the areas. It has an impact in all areas of the company, generating lower costs and execution times in building. However, it is recognised that no application of the system has been made in the subsequent maintenance phase.

Specifically, the HUBE system provides improvements in the following processes:

- Production management executed daily;
- Management of human and material resources;
- Analysis of production carried out in comparison with planning;
- Management of contracts with suppliers;
- Generation of pro forma invoices associated with the production;
- Elimination of meetings of works "in situ".

Its application in the management of the construction process is realized through the following applications/systems:

- Employee portal
- Control of presence via mobile
- Document management
- Process management
- Competitiveness plan
- Progress indicators
- goals
- Competency management
- Performant assessment

The system establishes that all processes have input and output indicators. The combination of data entered by the profiles, as well as those generated by the system, allow obtaining information of the entire construction process.

- Information input.** Tablets are used to incorporate information and data into the system, which are used by site managers and managers. Thus, the first receives the tasks to be carried out during the week, while site managers receive the hours of work that workers on the site have to do, filling the corresponding hours for each of them.
- Location.** Each element has a location granted by GPS coordinates. So that the project makes a forecast of the cost of each element (materials and time), while the project manager indicates the actual-effective cost (in materials and time) of each element. As a result, the actual cost and the deviation from the budget could be known each week.

Monitoring indicators

Generated indicators are structured within the *competitiveness plan* designed by the company. Its objective is focused on increasing employee and customer satisfaction, product quality and company productivity. In order to achieve these goals, indicators are defined in all areas to measure results. Currently, indicators are implemented in a pioneering phase and they will be fully applied in the medium term.

This plan is based on three strategies: a) *communication*: suggestions for continuous improvement are sought from interviews with workers and meetings from all areas. All progress indicators are published, being accessible for all. Its objective is to make visible improvements. b) *participation*: groups made up with staff from various areas are set, with the objective of having information of the value chain (clients, suppliers). At least three persons from each area are included. c) *recognition*: strategy made from all the progress indicators. Each job position is reflected and evaluated by competencies.

Indicators refer to four major goals: customer satisfaction, product quality, productivity and worker satisfaction. These goals are evaluated in each of the 10 areas that make up the structure of the company, having specific indicators for each of them

At present, this plan of indicators has been developed by HR. Once approved by management, indicators of each area are revised by their managers. According to the company, it is necessary to delimit and define indicators' usefulness and relevance. Those indicators that are not providing information or are not relevant (either for management, HR, managers, or workers) are not considered. From the HR department, the aim of this plan is to increase worker satisfaction. To do

this, evaluations and training must be carried out, as well as, groups participation on improvement must be made. For them, knowing hours of work carried out by the subcontractor, accidents, absenteeism, days lost due to accidents, etc. are very valuable data for improving the work construction.

For the company, changes have had a positive impact: a) it has improved the coordination between the different areas and departments, as well as, the organization of activities and tasks “on site”; b) it has meant greater “self-control” of the construction process: each worker knows “what he has to do, when he has to do it and how he should do it. If there are changes in the construction process, the worker knows what to do or who he has to turn to”. According to the company, motivation of the workers has also increased as a result of their better understanding of the whole process.

Relationship with subcontractors

As it has expressed by interviewers, this way of working has reordered the value chain and its relationship with subcontractors. The system allows each company to have its space on the construction site without hindering some activities with others.

However, at the beginning of the process, the company had problems with the integration of subcontractors, due to the difficulty of finding companies who want to adapt to the system. One of the main barriers has been the measurement of the times of their work (walls, electricity, painter, etc.). As the company expresses, if data is entered by estimation, results are not good, neither for the parent company, nor for the subcontractors. From its experience, if the subcontractors agree to quantify work processes, they also achieve results in terms of time, resources and costs. In general, the company is changing the way of working with subcontractors. Most of them no longer want to change to the traditional way of construction, after trying the system.

For the company, this represents a benefit because it creates a solvent supplier, while for the subcontracted company it reduces uncertainties. In this respect, it is mentioned that there are two preconceived ideas they have to face: the low quality of the work carried out in construction and the high turnover of companies. It is considered that this has caused a lot of damage to the sector, very fragmented and with short-term resources.

Investments and costs

As a medium-sized company, the digital transformation has involved a significant economic effort. The company has invested more than 3 million euros (90 thousand euros from the CDTI) over the last 6 years. It highlights the relevance of technological innovations, in a sector in which there are many expectations of return. In this respect, some company’s investors wanted to stop participating, for not seeing their expectations fulfilled in the short term.

4. Impact on employment

Employment dynamics (hiring, downsizing or transformation)

The digital transformation has not produced a reduction of jobs in company B, but hiring dynamics and transformation of professional profiles have been registered. These dynamics are related to the structure and activities of the company: the construction staff is small (construction manager, manager and worker-crane operator fundamentally) and activities and works on the construction site are carried out by subcontracted companies. The project contract defines necessary professional profiles that are used in the work.

The staffs of the company have a medium-high level training (university education). This level of education has presence in all areas of the company: financial and administrative areas (economists); Technological (computer) processes; studies and planning (technical architects and engineers); sustainability and energy efficiency (architects); promotion and delegation: (architects); projects (senior architects and technicians); Production - Site managers (engineers, technical architects); commercial and marketing (commercial training).

Professional profiles: skills and roles

Hiring processes with no specific profile were requested, but rather profiles with greater training and their willingness to learn the company's work system (software and tools). The company provides an internal training process for new employees.

According to the company, profiles must have competencies oriented to results, clients, teamwork, initiative and the ability of adapting to change. It gives more importance to "how" than to "what" is known. Technical knowledge is the easiest to learn, while competencies are linked to the attitudes, experience or motivation of workers, as well as their willingness to work with the system, assures the company.

Regarding roles, it is highlighted that new profiles facilitate a more efficient development of processes. Their role is to get the most out of the technologies. The most prominent new roles are as follows:

- Project development with a new definition;
- Study of the projects, looking for the most efficient execution;
- Suppliers collaboration, with all the companies involved in the construction process;
- Execution control, trying to adapt the reality of the work to the existing planning;
- Monitoring of execution, both form and time;
- Study of the executed works, looking for improvement options.

For new profiles, the following added knowledge is identified:

- **Project specialist.** To handle used technologies, all demanded profiles have appeared. The company provides specific training for its own applications and software (HUBE);
- **Architects and engineers.** These profiles must also have knowledge of pre-construction processes;
- **Project managers.** They must have knowledge of the management of work resources or the management of the production centers;
- **Technical office.** The entire technical office has knowledge on *Revit*, which is the design software that is used in the company. There are people who are experts in the use of it and people who continually be trained;
- **Other figures:** BIM manager is not considered necessary;
- In addition to training, the company points out that motivation and availability to be trained by the new profiles are sought.

As a result of having their own construction system, the company has designed their own professional profiles. Specifically, this has had an impact in several areas: (a) in *prefabrication*, in which professional profiles are asked to implement new skills; (b) *Passivhaus Certification*, which also implies certain requirements in professional profiles (for example, those profiles working with windows with special seals); and (c) in the *construction site*, in which there has been a reduction of

certain profiles (for example, bricklayer, tiler), combined with the increase of professional profiles linked to assembly and prefabrication (for example, dry partitioning).

Professional training: profiles and demands

In order to face changes, the company has had to train its staff, requiring specific training, which does not exist outside the scope of the company.

Training actions have been articulated under the company's training plan. This plan is elaborated by the HR department, which receives the training needs of the different departments. The plan is reviewed by management and has the participation of the workers' legal representation. Regarding contents, internal training focuses on acquiring the knowledge and skills necessary to use the company's tools.

5. Impact on working conditions

At large, the impact has been positive according to the company. The greatest impact has been on autonomy due to teleworking, although an intensification of workload has been registered. Likewise, risks in the field of health and safety have been reduced.

Specifically, the following impacts are identified:

- **Workloads.** Prefabrication reduces work on site, which intensifies planning and manufacturing. In the office, specific work overloads have been registered, but that has facilitated the subsequent work of the rest of the phases. In general, time and costs are reduced.
- **Working time.** The system allows greater productivity and connection to work and more specific performance and time management. The use of the system has not translated into a general increase in working time.
- **Coordination-participation.** More autonomy at work is reached. It improves the contact with delegations from other provinces (Madrid, Valencia). Regulations are different according to the provinces and the system gives a more coordinated way of working. Contacts between departments are greatly streamlined, which it means an improvement for customers and also for workers.
- **Stability-precariousness of employment.** With this way of working, more employment security is registered, because there is a forecast, which allows reducing the turnover of personnel on site.
- **Security and health at work.** With the activities and workers' reduction, working risks have decreased. Prefabrication also allows increasing safety on site (for example, facade assembly). Working remotely, building phases are managed by the company better (it is known which operators are on site, what they do, hours they have been, etc.). The work of managers and construction managers is easier.
- **Quality of work - way of working.** A direct relationship between the quality of work and the way you work is identified. According to the company, if everyone is informed about the process and tasks, (what information, how and when they need it), this will have an impact on increasing the quality of work. Changing the whole work system is the real challenge. Tensions arise from the simplification of traditional tasks. Once the system is incorporated, it is valued positively. Workers have greater knowledge of the project as a whole and they could see that their work is recognized.
- **Work-life balance.** Technologies have allowed greater flexibility in managing working times.

- **Professional categories.** As a result of digitization, changes have registered in the company (creation of a technical office vs. hiring external architects).
- **Wages.** The company offers a greater added value, and so its benefits. Wages were able to increase in this context. According to the works council, each year wages have been increased, as a result of the collective agreement, or because of the improvement of different areas (digitization, *passivhaus*, etc.). There have been no complaints from the workers.
- **Versatility.** The company demands workers with intermediate and higher education, with a high degree of versatility. The company recognizes that this has to be compensated with a plus of versatility.
- **Polarization.** No changes or substitutions are detected between manual workers (operators) and non-manual workers (technicians), because different knowledge is needed. There are certain differences between profiles during the assimilation of changes, specially the oldest ones.

From the workers' point of view, there are no great reserves. Although it has been a long process with specific moments of work overload, there have been no complaints about the implementation of the system. If anything, complaints have been registered for its initial operation, for implantation failures and for not being 100% working with the system.

According to the company, people are more involved in the construction process, having a greater understanding of it. The more manual and heavy activities, such as bricklayers, are being replaced by others that require less physical effort (assemblers). In sum, the system improves the self-perception of work.

Finally, it is noted that the company (and the sector) must make an effort to attract young personnel, in which job security and not seasonal employment are seen as two of the main factors to attract them.

6. Drivers and barriers to digitization

Based on the information provided by the company and the interviews carried out, a series of drivers and barriers to incorporate new technologies have been detected. Among the drivers can be noted the following ones:

- **Business decision.** The main driver found in this company has been the strategic decision taken by the management. It has been motivated by its size (medium-sized), where decisions can be made more quickly than in bigger ones;
- **Productivity and Customer.** Company's decision has been based on two aspects; on the one hand, by the search for greater profit, greater productivity and company viability; on the other hand, due to client's demands and consumers.
- **Own tool.** The company has its own digitized tool differentiated from other companies in the sector. Being adaptable to the company's needs, this tool has produced better knowledge of the production processes and final returns.
- **Workforce.** The company has a young workforce with high qualification profiles, since all the staffs have higher or intermediate studies. Most have had experiences in other companies in the sector where they worked with digital tools.

On the barrier side, this company mentions various factors that can slow down digitization and the incorporation of new technologies.

- **Suppliers and subcontractors.** The sector has a structure whose tendency is to subdivide the value chain. This subdivision has created difficulties for the company in finding suppliers that provide comprehensive construction solutions and that could accompany it in the digitization process. As alternatives, it is proposed to unify efforts and create alliances where the promoter companies can play a driving role and favour the change of other companies along the value chain.
- **Investment.** According to the company, there is a lack of private investment in the sector. It is important that investors in the sector could understand the sector's situation, both its strengths and its weaknesses. There are investors who have very high return expectations that are then not satisfied. Digitization and new technologies have meant a significant investment for the company, which has resulted in an investment of 3 million euros in 6 years.
- **Training.** The decision of having its own tool has meant that staff was trained. The company had to dedicate time and resources for training of existing staff as well as to any new ones.
- **Structural change.** Technological change supposes a transformation of the way of doing things and people have to get used to it. Sometimes there are reserves or doubts on the part of the company (workers, departments, agents), although when the step is taken, it is seen as positive. Sometimes, for the company, it has been difficult to find new staffs who want to make that change.

7. Labour relations and social dialogue

In this company there is a good dynamic of labour relations with a fluid relationship between the works council and the HR department, which has been highlighted in all the interviews. In recent times, as an effect of COVID-19, a temporary labour force adjustment was negotiated, with the agreement between workers' representation and the company.

Regarding labour relations, it should be noted that the company is covered by the state construction agreement and by the provincial agreements where the company has a presence (3 different provinces). At the moment, there is no agreement or company agreement.

Works council is made up of 5 people, with representation from a single union (UGT), four members come from construction personnel and the other from the office area.

New technologies have facilitated the relationship between committee members, as well as the relationship between the works council and the HR department. Communication is streamlined through the company's IT platform and remote communication is allowed regardless of the workplace.

In the digitization process two phases can be differentiated regarding labour relations:

- Firstly, the implementation of the company's own digital platform (HUBE), taken by the company as a strategic change in the management and work organization system. In this phase, workers representatives participated in training actions (planning and implementation);
- Secondly, the implementations of a new productivity plan. This plan to be carried out takes indicators that come from the tool (HUBE), along with other indicators proposed by the company's management, as well as those in charge of the area and those proposed by workers themselves.

In this phase, the works council is called to participate. Both for implementation and adjustments of indicators, its aim is to contrast the monitoring in monthly meetings between both parties.

Both parties are open to a fluid dialogue on all matters addressed to digital change, and it is necessary to translate them into future agreements between both parties. On the part of the company, working by objectives, investments in new technologies or staff training are raised as issues to be addressed.

From the works council's view, it is pointed out that monitoring does not imply a greater control of the workers and psychosocial risks related, in terms of stress or work overload. The autonomy of workers in their workplace must also be taken into account in the negotiation process, to the extent that monitoring cannot lead to the automatic performance of tasks without room for workers. Likewise, workers' participation in the definition of indicators is remarkably important. They intervene in the process, if not, their possibilities of autonomy and promotion of work may be limited by measuring their performance.

According to the interviews, digitization could bring a new scope of negotiation, with new matters of negotiation. Besides wages or working conditions, digitization would have an impact on these issues. For them, sectoral level (both at the national or regional level) is the place to bargain issues derived from digital change. But, it is also important to negotiate at company level, since evaluation and monitorization can be seen by some workers as an increase in control or greater demand. Thus, social dialogue and collective bargaining could facilitate the implementation of new technologies, making workers protagonists of the process.

8. Covid impact: the role of digitization

As a consequence of the COVID-19 pandemic, all non-essential activity of the company was shut down in March 2020. The activity stopped during two weeks and after this a limited reactivation of activity was registered. In this context, the company proposed a temporary labour force adjustment to the works council. An agreement on temporary employment suspension was signed by parts. With this, the company was able to face the temporary reduction of activity without a lay off staff.

After confinement, prevention protocols were established in accordance with health recommendations, operating in the safest possible way, both in office as well as in the production phases on site. It should be noted that since March 2020, when work stopped, the activity was gradually returned. In July, 100% of the workers had already returned to work, and the company made new hires after the summer.

Workers' representation has actively participated in this process from the outset. Both, company and workers' representation, mention that this collaboration has been very positive, in reducing uncertainty for the workforce. In this process, the transparency by the company is pointed out by interviewers, regarding the economic situation and the planning of reincorporation to employment.

In office, various initiatives were taken, such as teleworking (first phase of the pandemic) or an intensive workday (second phase), with the aim of not eating at the workplace. Especially sensitive people, with asthma, allergies or pregnant women, have had preference in adopting telework or flexibility in work shifts. At the construction site, some changes were proposed, such as distance, as well as taking extreme precautions and protective equipment and minimizing contacts in changing rooms. The result of these measures was the absence of contagions at work.

The digitalization of the company, prior to the pandemic, facilitated the adoption of measures such as teleworking among office staff. All documentation was digitized and easily accessible from a centralized server. At the construction site, distance was also facilitated, as a result of the previous planning of tasks and jobs, already incorporated in the digital tool of the company.

According to interviews, the situation lived by pandemic will be a driver, both for the company and sector, in the adoption of digitization and new technologies. In particular, shared access to information will be promoted for office, while at the construction site, presence and distance controls will be promoted.

Case C. Big company with presence in different activities

1. Main characteristics of the case study (companies, actors)

It is a large business group dedicated to construction. It was born in 2007. At the beginning the company had a lower turnover volume, which had been increasing until 2019. Currently, the company comprises all stages of the construction-real estate cycle, expanding its activities towards maintenance services, reforms, rehabilitation and rental management (facility services and retail).

Its position in the value chain comprises seven major activities: Land and business development (soil, market and feasibility studies), project development (preliminary, basic and execution), Construction (facultative management and project management), delivery of promotions and after-sales service, rehabilitation, maintenance and operation of real estate rentals. In this sense, the group is structured in five large areas: Construction, energy, services, industrial and real estate. The group is organized in ten companies.

In the construction part, it is focused on the real estate sector although it also has some civil works and rehabilitation projects. This area constitutes the main activity of the company by turnover volume (80% approximately, with some light variations according to the economic cycle).

In the real estate area, it can be noted that both own and third party promotions are being carried out. The rental area is a new area of specialization that is being developed under the Build to rent formula. Likewise, a strategic change has been made in the company, reducing the presence of the company in small works and focusing on larger works, with a greater added value.

In the energy area, they are developing wind and photovoltaic parks. They have parks under development with an equivalent production of 500 megawatts approximately.

In the services section, they are developing a business line based on maintenance and rehabilitation services for financial clients and insurance companies. This area is carrying out about 75,000 performances a year. It is one of the areas where digitization and the incorporation of new technologies are also being introduced.

In the Industrial section, an industrialized construction project is being carried out, through an alliance with a company focused on the construction of precast concrete and other materials, both for facades and interior partitions. From this alliance, a precast factory has been created in a region near Madrid.

In 2018 it had a net amount of turnover of approx. 500 million Euros and it had 1,300 people employed in 150 works in Spain and Latin America (Colombia). Most of the turnover corresponds to the construction activity, followed by services and real estate.

Women represent approximately 18% of the company's staff and are mainly found in the category of Graduates, Technicians and Administrative Officers. More than half of the company's workforce is classified in this category (approximately 58%), followed by the category of officers (approximately 36%).

2. Digitalization and innovations

In 2017, the company considered the introduction of new technologies although it had already done some projects in BIM before. In that year a Convention was made to carry out a strategic plan for digital transformation. This plan represents a turning point where a change of mentality is generated in both management and construction staff.

Main technological innovations

The company incorporates various technological innovations, among which the industrialization of the production process stands out, as well as other additions such as the digitization of processes and tasks, the incorporation of digital management software, the use of applications and digital devices. This introduction of new technologies has led to a reduction in costs of around 30%, in addition to the beneficial effects in reducing waste on site and therefore a lower impact on the environment.

Digitization of processes and tasks, incorporation of external management software

The change process began with the standardization of all processes. Once the normalization of these processes was achieved, the step to digital transformation began.

In the first phase, they began to work with BIM, 3D modelling and from there they moved on to 4D, by including within the project phase, the part related to studies and completion deadlines for tasks. The digitization of processes and tasks has also affected a fundamental process that also improves the business area.

The incorporation of new technologies in the purchasing department is an example of this dynamic. This department had been originally very analog, due to the requirements and need for visas and signatures. An external digitization application was introduced firstly, and later processes such as BIM, 3D modelling and 4D have been included. Lastly the digitization has arrived to cost and deadline control systems. Many of the digitization processes (paper less) have been motivated by requests from the personnel on work sites, since the paperwork was very demanding and it was difficult to handle so much documentation.

In a second phase, a new digital ecosystem has been established in the company. The activities of the real estate and services area have been digitized. In the construction area, the processes of fundamental study, planning, purchasing and cost control have been digitized. All areas transmit information in a digitized way to the financial department. A centralized management system has been established. This new software automatically reports to the finance department, which in turn operates digitally. This phase has lasted a yearlong approximately.

The third phase in the implementation has dealt with the digitization of the plans themselves and their inclusion in BIM modelling, although it has gone beyond the BIM methodology. This third stage, still in the development phase, is involving the incorporation of Big data into the construction process. This phase is expected to be a relatively expensive process. This process could allow anticipating a rise in material or labour costs and automatically and centrally adjust the budgets of the different projects planned or already open.

Off-site precastings

Company C has also started manufacturing projects in locations other than construction (off-site). This change has been motivated by a situation of great volatility of costs as a consequence of the lack of qualified labour and the high variability of the costs of supplies and raw materials.

The standardization of products and tasks has been the crucial aspect in this process. This process implies the previous definition of a series of tasks or work sheets. For example, for making a certain standardized product, the company needs to configure descriptive templates that allow standardizing the models to be produced. These templates range from the simplest to the most complex questions. Once all the characteristics of a product are parameterized, the model is sent to the partners with the purpose to be manufactured.

A Factory has been created in a province near Madrid where precast and structural panels are built. The partners are included from the beginning of this process. This involving ensures the critical path of the work (Critical Path Method), which allows to calculate the order and deadlines in project planning.

The industrialized system allows the company knowing at all times the quantity and quality of the products that are being manufactured. Since the BIM models are loaded in the digital system, all the processes of the factory are controlled together with the planning of the work and the assembly. The management of all this information is done through a commercial program where a detailed BIM model is introduced, with the requirements, together with the planning of the work.

This information is received by the factory who builds the product. Once built, it is sent to the construction site at the precise moment for its placement (just-in time process). This supposes advantages of 70% in costs and it is intended to achieve 20% of the whole construction activities in industrialized processes.

It is expected to be a substantial improvement in matters of occupational hazards because the workspace is much more controlled in a factory than in a construction site, especially in matters related to inclement weather. It also has impacts on possible production stoppages at works due to weather issues. Also manufactured production can have benefits in relation to production management. On the other hand, there is no customer mentality for these new types of buildings because they associate these new construction processes with poor quality.

Applications and digital tools on site

Digital applications and devices are being used, both on-site and in the pre-sale and post-sale phases (maintenance and rehabilitation).

Examples of this use can be found in the service area, where the personnel dedicated to fixing the small damages prior to the delivery of a home, or the rehabilitation of spaces and maintenance in after-sales services, is equipped with a device digital (Tablet- Smartphone) with internet connection and GPS.

These digital tools allow the location of the workplace through GPS, being able to report the start and end time of the task in real time and sending observations and the result of the work carried out (generally a video or photograph) through digital media. The digitization of this process does not imply a reduction in personnel, because the work team is still necessary. But a faster completion of work and a higher quality of service are allowed.

Incorporating sensors connected to the internet (Internet of things -IOT-) in some elements of residential buildings is another technology that is being explored. This new technology is carried out in new buildings made on a rental basis, to facilitate maintenance service. This strategic change from build to sell to build to rent, digitized maintenance services and savings achieved with BIM, can amount to 75% of savings over the use cycle-life of a rental building which can be 30 or 40 years long.

3. Impact on the organization of production and work

The incorporation of new technologies, BIM and industrialization has been coordinated by the planning, control and management department. In its origins, prior to this technological change, the company managed the processes with a balanced scorecard in which all the processes were included. The digital change was managed from project management subsequently between 2010 and 2017. This office has gradually become an internal department for digital transformation and business projects.

In this process towards greater digitization, internal tensions have been generated, and this department has solved them, because digitization involves different departments with different cultures and all departments had to assume a change in the way of doing their respective tasks. In this process, it has been very important to convey the need for change to the people responsible, so that they can transmit this information to the entire company.

It is important that an internal team manages the change. It is true that there are external consultants that could advise and accompany these processes, but this type of consulting companies is not always specialized in the construction sector. The company is best known by someone inside. This digital transformation office came to be made up of 14 people, but currently, its number has dropped to 5 people as a result of the decrease in the pace of digitization.

Processes and tasks

The digitization process has implied a major change in the production process. In the traditional way of construction, there is a lot of dependence on the people who are on site, so the quality of the final product is highly variable, while in a standardized and industrialized process the end result is more homogeneous.

Standardization is remarked as essential in this pathway, regardless of digitization stage. Costing processes and procedures have been planned and defined in all digitalization stages. All processes and areas of activity are affected by digitization. At this stage, purchasing and services are two large areas of activity which are pointed out as examples of this standardization.

Once the processes are standardized, their beginnings and ends have been established and all together fit into the entire production process; the tasks within each of these processes can be done in a more flexible way. Working with standardized processes allows covering a greater range of work in the on-site work.

Project and procurement

It is important to include partners in the early stages of the project, as has been done in the industrialization process, where partners have been included throughout the process, including them in the early design stages. The fact of including the partners from the beginning allows the loyalty of the partners and therefore also allows a stabilization of the prices, without there being unexpected rises or falls.

In **purchasing**, the digitization process began in 2017 with the introduction of new management software developed internally. This tool has allowed a centralized control of spending, purchases, suppliers of all projects. This tool is used by the purchasing department, as well as the finance department and production department. This tool makes communication digital and more smooth.

In purchasing processes, having got the signatures of all the people involved is an essential requirement for this department. Previously, this requirement was done on paper, and the collection and payment processes were very difficult. Currently, due digital signature procedures, this process is much easier. The benefits of digitization are direct, but it is true that there are some supply companies which are afraid to share their information, because they are afraid of seeing their margins reduced. The relationship with the contractors has been positive in this regard. The communication of the purchasing department and the production department (on-site work) is much faster and everything is recorded and written, so it is much easier for all parties.

The fact that everything is written down in the production process is seen positively for the company, so it can learn from mistakes for the future. However, this represents a change of mentality, because not everyone likes putting mistakes in writing.

The positive impact on the purchasing department is that coordination with the rest of the departments is much faster, clearer and cleaner. For example, the purchasing manager could be on its own duty and not preparing documentation, the same thing happens on site, the site manager could be thinking about construction and not about documentation.

In **on-site work and maintenance services**, the uses of digital applications and personal electronic devices facilitate the tasks, because anyone knows at what specific point where is placed its tasks, with a GPS location, and once the incident/work has been done, a photo/video could be sent with the results of the tasks. That process raises productivity.

One of the positive impacts noted is the **reduction of waste**, which is calculated as a 60% reduction in the waste generated on site, as a result of digitization. Accounting for both the reduction in the number of transport trips to the construction site, as well as the excess of product discards on site.

Relationship with subcontractors

Before digitization, the control of the on-site work and of the subcontractors were tasks that implied a great effort, since both were a necessary work but they took resources away from the fundamental task that is the on-site work. This digital transformation allows this control to be carried out in an automated way, so that the work staff is dedicated to doing their job and the time they spent on documenting the work is shortened.

The control and monitoring of suppliers is centralized, taking into account the fulfillment of a series of requirements as well as their monitoring, so that an increase in the quality of the products and services provided is achieved. Before digitalization, the control and monitoring was carried out in each on-site work individually. In a digitized construction process, the information is shared between all the on-site works. The information flows more quickly and transparently. Also, using this centralized software, there is evidence that the information has been transmitted so it is possible to ensure the traceability of the information and avoid delays. In the relationship with suppliers and subcontractors, it is noticed that there are companies that find it more difficult to adapt into a digital way, but it is not expected a shift in subcontractors due to issues related to digitization.

Investments and costs

The digital transformation has involved a significant economic effort in this company. The decision was provoked by the fact of preventing volatility in the costs. In the last years, the costs of the production process have risen 30%. In this sense, digitalization, the introduction of new technologies and industrialization are seen as a way to cut costs and make them foreseeable.

Therefore, It is remarked a gap between the amount of inversion required to digitize the company, the long term return of this inversion and the short term necessities of the company. This gap stresses the decision making process. For this reason, it is remarked the necessity of a clear instruction given by the direction to all the levels of the company.

4. Impact on employment

Employment dynamics (hiring, downsizing or transformation)

It is not foreseen new hiring of personnel in the office areas in this company. However, in the industrialized part, new jobs can be created since it is a new area of activity.

A first temporary reduction in employment (short-time work scheme) has been placed related to the pandemic situation caused by COVID-19 and the subsequent situation of lockdown and non-essential activity. Subsequently, there has been a loss of employment as a result of the decrease in demand in residential housing, the main activity of the company.

Professional profiles: skills and roles

It is not foreseen the hiring of new profiles in existing areas. But through internal training and learning through practice, it is expected that the existing staff will be able to adapt to the new tasks that are entitled. Centralized management tools are used by technicians, while applications for digital devices (Smartphones and tablets) are used by people in charge of the construction site. Both types of tools are considered easy to use and the creation of new professional profiles has not been seen as necessary.

In the new industrialized manufacturing area, it is expected the creation of new professional profiles linked to new industrial processes, both related to factory management and the production of industrialized products.

Professional training: profiles and demands

There has been developed in-house training, but since the management software and application tools on electronic devices are fairly intuitive, most people self-teach the functioning of these tools.

5. Impact on working conditions

General speaking, the impact has been positive according to the company. The greatest impact has been registered on transparency, control, coordination and remote work due to centralized information management, although an intensification of workload has been registered occasionally. Likewise, risks in the field of health and safety have been reduced.

- **Workloads:** Some punctual overloads of work have been detected, but it is highlighted that all documentation and interdepartmental management are better managed with digitization and paperless procedures. These new processes facilitate the management of specific overloads that may exist. General speaking, the introduction of new technologies implies a reduction of time in tasks that are not central to the workers, so they can dedicate more time to the tasks that are their own.
- **Control and transparency.** The fact that all the information is in a single and unique tool provides greater transparency to the information, this new situation is good for the company, although a change is also demanded from the company, to the extent that errors or dysfunctions should not be attributable to the staff and these mistakes should be used as a starting point to improve production processes.
- **Telework and work life balance.** Remote work has been introduced with the pace of the pandemic. The staff in offices are involved in telework schemes (mixed system, both presencialy and remotely). This mixed system is showing that work continues to go ahead without being in the office, and therefore it could be possible that a mixed system of presence and telework would be maintained after the pandemic. It can be very positive to improve the work life balance. It also stands out that it reduces the risk of accidents in commuting.
- **Coordination of tasks.** Digitization is enabling a better coordination between departments and within departments. The information related to the supplier companies is also centralized so that the personnel in charge of each on-site work have a greater decision-making capacity in the action with the subcontracted companies.
- **Security and health at work.** On the one hand, it is remarked that there are developed safety and security courses at sectoral level which enable the workers to work in safety conditions in on-site works. The company requires the accomplishment of these courses to the workers in on-site works. The verification of this documentation is centralized and automatized by the company with the management software. In this sense, it is seen as a way to fulfil the normative regarding security and health. On the other hand, industrialized production allows improvements in safety and health at work, since it takes place in a safe environment without weather risks.

From the workers' point of view, there are no great reserves. Although it has been a process with specific moments of work overload, there have been no complaints about the implementation of the system. If anything, complaints have been registered for implantation failures and for not being 100% working with the system. According to the company and the workers, as a result of the digital process, the staffs are more involved in the construction process and with a higher commitment, having a greater understanding of it.

6. Drivers and barriers to digitization

Based on the information provided by the interviewees, a series of drivers and barriers have been detected. Among the drivers can be noted the following ones:

- **Business decision and innovation department.** The fact that digitization is promoted from an innovation or management office (PMO), with the support of management, means that the entire company is aligned with this decision to introduce new technologies. It is also important to facilitate the digital change to the workers enabling a technical support service to which work and office staff can ask in case of doubts in the use of digital tools.
- **Productivity and improvement of productive processes.** Digitization increases the productivity of the organization and improves coordination among departments. An improvement in coordination with subcontracted companies is also achieved. A centralized information is provided on the supplier companies in all the on-site works. These processes increase transparency and reduce prices and time variability in the different projects. It also promotes a greater capacity for forecasting and predicting into the future.
- **Staff: offices and on-site work.** Involving the staff in the digital change is a must in order to not find resistances to the digital change. It is important to allow the staff to recognize their own benefit in digitization.
- **Prior standardization of processes.** Standardizing processes and tasks is one of the issues that have accelerated industrialization in this company. Once this step had been achieved, it has been possible to go further by establishing the industrialization of some products related to facades and partitions.

On the barrier side, this company mentions various factors that can slow down digitization and the incorporation of new technologies.

- **Investment and costs.** Digitization and the introduction of new technologies require a large investment that is not compensated in the short term. Therefore, it is important that the company's decision is clear and firm so that all the levels in the organization follow the planned path.
- **Structural change.** It can be noted that structural changing is the most important matter in these change processes. There are people who can find the changes harder. Therefore, some people can have good performance in the traditional system, but they could have difficulties adopting new technologies.
- **Expectations vs reality.** The development of an internal tool is positive because it fits better to the production processes and implies that improvements are made in the process itself. However, this process is progressive and sometimes the tool suffers some incidents. These incidents in the functioning may cause people reluctance to changes, which on the other hand disappears once the incident has been solved and people participate in the solution. It is noticed that if the system works 100%, every process is much more agile, and the timing is greatly reduced compared to the traditional way of working.

7. Industrial relations and social dialogue

The industrial relations at the company have been covered by the sectoral collective agreement. There is a works council (WC) built up in 2020, which is made up of eight representatives. Therefore, the industrial relations are at an initial stage in the company, thus the dynamics of social dialogue are gradually beginning with the advice of delegates from the majority unions (CCOO and UGT).

In the first phases of the social dialogue, the company and workers representation have had to face a short-time work scheme agreement, in the first half of 2020 and latterly, in the second half of 2020, an employment reduction agreement as a consequence of the pandemic situation and the drop in activity. This process is estimated to have affected 20% of the workforce. A slight increase in employment is observed in the first months of 2021, but without reaching pre-pandemic levels. That first phase of industrial relations has been carried out by the company and the WC with the advice of union experts on restructuring.

At the beginning of 2021 a new phase of industrial relations has begun with the dynamics of information, consultation and negotiation. This new industrial relation's phase addresses traditional issues as well as the effects of digitization on working time, health and safety, or gender equality. In parallel, the work council has also proposed to address some matters directly related to digitization, such as the effects of the incorporation of new technologies on workers, the different ways of signing or teleworking.

The work council has proposed to address in the near future issues related to training, re-qualification and digital skills and new working rights such as the digital disconnection. At the moment there are no requests from the staff to the workers representation regarding specific improvements related to digitization. Although there are specific concerns regarding the difficulty of using common spaces as a result of capacity limitations related to COVID-19. Also it is remarked that Information transparency and a proactive dynamic of industrial relations can help reduce the uncertainty of the workforce in situations of loss or reduction of employment and in new and stressful situations like a pandemic.

8. Covid-19 impact: the role of digitization

Digitization is improving the communication process among departments and within departments. It also enables a greater traceability of processes. The COVID situation has accelerated the dynamics of digitization. It noticed that digitalization has allowed them to keep office activities in a lockdown situation. In that sense, maintaining production in central services has been made possible by digitalization. Managers and workers agree that without digitization it would have been unfeasible.

The situation of lockdown in the works has been decisive, and the first damage was the stoppage of production and later a limited resumption of activity. Digitization is expected to accelerate as a result of the COVID pandemic. In addition, teleworking can promote a situation of work-life balance, in which the well-being of the workforce is promoted and this results in greater productivity. Teleworking also avoids the risk of accidents when commuting to work.

During the COVID situation, security measures related to COVID have been increased, such as entry and exit flexibility, to minimize the possibility of contagion. These measures have been reported to WC, but they have not been negotiated because the situation has been very precipitous. In this new phase of industrial relations, the dynamics of social dialogue are being more enriched and fruitful.

Environmental impacts

Standardizing and sequencing of tasks in on-site works allows the reduction of unnecessary trips as well as the reduction of discards of raw materials. Thus, reducing waste in on-site works is a result. Therefore, the company is reducing its ecological footprint. In offices, digitization and paper-less activities also allow an environmental improvement. In maintenance services, the use of IOT in maintenance-sensitive machinery could bring improvements in the carbon footprint by reducing the number of technical services trips.