Article

Development of a Pragmatic IT Concept for a Construction Company

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Abstract: The paper focuses on developing a comprehensive and pragmatic IT strategy for low-margin construction activities, which forms part of the realignment of the general business strategy and on refocusing the operational model. The main elements of the IT strategy formation are analysis of the current IT environment in terms of software and hardware, carrying out a gap analysis, and developing individual functional digitalization strategies in construction execution based on BIM (Building Information Modeling), business administration processes, communication, business intelligence (BI) and reporting, and data security. Further, a large emphasis is given to the sustainable strategy implementation in terms of hardware and software readjustments, their integration, user trainings, and defining the way forward. Research methodology and initial, chosen results of an extended questionnaire and construction company staff interviews are presented.

Keywords: information technology; sustainable development; construction company; hardware; software; strategy; BIM

1. Introduction

In our present daily life, information technologies are indispensable and the advances in automation are developing fast. It is a revolution that affects all areas of our personal and business environments. Digitization influences the rapid development of activities and processes and enhances communication, and, as such, is lifting barriers. However, there are very individual levels of technological advancement in different areas of life and industry.

At present, the most advanced areas in industry are businesses in information and communication technology followed by the financial sector. A slightly lower technological advancement is shown by media and entertainment industries followed by electronics, automotive, and energy companies. Construction is one of the industries with comparably low digital development.

Many reasons can be found like comparatively low entrance barriers, high levels of competition, and low margins in line with limited capital resources. Other arguments may be constructing unique buildings in remote locations with a very dispersed range of suppliers, which are—partly for legislative, regulatory, and educational reasons—still used to a paper-based environment. Further, construction processes are complex, in general with a low degree of repetition, and very often unpredictable.

Although in this industry IT technology was successfully introduced in all areas of administration and communication, e.g., accounting, product estimation, project controls, time scheduling applications, computer-aided design (CAD), and communication, the core business process of construction production is still lacking major improvement supported by digital technologies.

Therefore, a strong need for construction companies emerges to create and update their IT environments through systems improvement; integration and modernization of work tools for
management and execution of site operations; and improvements of site equipment, materials and other uses of supporting IT hardware and software. In turn, the cooperation and interaction of the individual participants need to be improved in all areas of the business.

In the following, we present research undertaken in a large construction company, related to choosing the best IT/business alignment options. Section 2 presents the ways the research methodology was formulated, including a chosen literature review and methodology description, created for a given state of the company and its performance. The present IT strategy and related processes for better recognition of the enterprise’s needs are discussed. Section 2.5 gives a description of the main business processes taken under consideration for IT systems development. In Section 3, we discuss present and available software and hardware systems for different areas of company operations, like core business, reporting and controlling, legal and corporate compliance, security, etc. Section 4 shows elements of IT strategy formulation for different areas of the company activities and Section 5 shows sub-strategies (underlining training importance). Section 6 summarizes the research.

2. Research on Business Strategy in a Construction Company

2.1. Introduction and Literature Review

Strategy, in general, refers to how a given objective will be achieved. Alfred D. Chandler, Jr., author of Strategy and Structure (1962), the classic study of the relationship between an organization’s structure and its strategy, defined strategy as “the determination of the basic long-term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources for carrying out these goals” [1]. Strategy is important because the resources available to achieve these goals are usually limited. Strategy generally involves setting goals, determining actions to achieve the goals, and mobilizing resources to execute the actions [2]. A strategy describes how the goals will be achieved by the means (resources). Strategy can be intended or can emerge as a pattern of activity as the organization adapts to its environment or competitors [3]. It involves activities such as strategic planning and strategic thinking [4].

The company’s strategy and plans should be mission-based. The mission should set a credible direction for the future, expressing the company’s dreams and challenges. Such a mission sets specific objectives to be met by the enterprise in order to meet its needs. The organization’s objective is a set of intentions that directs it to achieve a given state. Appropriately formulated objectives should be concrete tasks that can be achieved within a certain time frame [5], such as improvement of the overall effectiveness and efficiency of operations, to allow for sustainable development or developing a more efficient organization structure [6]. Special focus can be given to further digitization of the company’s core and support processes.

Two ways to create business value with information technology (any business, including construction), resource structuring and capability building, were presented by Wang, N. et al. [7], based on data collected from almost 300 companies. Research shows that more business effect is generated in dynamic environments by IT capability building. This approach was recognized as relevant for the construction industry with its dynamic changes. As it is stated in reference [7], this general concept of (IT) development can be defined as the use of resources (tradable and nonspecific firm assets) and capabilities (non-tradable, firm-specific abilities to integrate, deploy, and utilize other resources within the firm). In other words, resources are the inputs of production processes, while capability refers to the capacity to deploy resources using organization processes. For this reason, we organized the methodology of the presented research with relevance to the existing resources and capability of the company, taking under consideration present software available, the organizational scheme of the company, and—equally important—phases of the construction project.

Business/IT alignment is crucial nowadays for modern construction companies. IT systems are developing very fast in comparison to the traditional and, to a large extent, inflexible construction industry. The introduction of changes in companies has to be stable and very well-prepared to avoid
major turbulence [8] negatively influencing company performance. All rules of disruptive innovation could be taken into consideration. Chan and Reich [8] clearly give the definition of IT and business alignment as “degree of fit and integration among business strategy, IT strategy, business infrastructure, and IT infrastructure”. In reference [8], the success factors for aligning IT plans with business are clearly stated: “1. Top management commitment to the strategic use of IT; 2. Top management’s confidence in the IT department; 3. Top management’s knowledge of IT; 4. IT management’s knowledge of business; 5. Business goals and objectives that are known to IT management; 6. The corporate business plan being available to IT management; 7. The IT department being able to identify creative ways to use IT strategically; 8. IT staff who are able to keep up with advances in IT; 9. Frequent communication between users and IT departments; 10. Business and IT management partnering to prioritize application development; 11. The IT department’s efficiency and reliability; 12. An IT department that is responsive to user needs”. These elements were taken under consideration during our research and preparation of IT strategy development in construction companies, namely, top managers’ decision; well equipped, informed and prepared IT team; making all personnel aware of changes; and listening to the personnel in relation to their IT needs with the development of communication between all interested parties.

Achieving the proper state of IT introduction or development in a business is a very difficult task [9]. It could significantly distract supply chain management, when improper software or not well-known software and hardware solutions are introduced. Even heavy, but not thought over, investment in IT fails to achieve improvement of organization performance. Only properly prepared interdependencies between decision making, activities, investment (in IT), and strategy could lead to improvement of IT use in the company. Reference [9] gave us direction for the internal questionnaire related to the IT system used (or planned to be used) by the company’s personnel.

The involvement of senior managers in the IT strategy development is crucial, as clearly described by Smith, H. A. et al. [10]. During our research this attitude was taken under consideration as a very important element and which allows for requested full flexibility of the strategy, facing a quickly changing IT environment. At this level of management, it is also easier to achieve not only the best communication with company personnel, but also—equally important—with clients [11] (sometimes very IT-demanding).

Success depends also on the size and organizational structure of the company—centralized or decentralized. Extended research presented by Mikalef, P. et al. [12] shows clearly (on a base of almost 200 interviewed companies) that companies “that opt for a centralized governance structure, as well as larger firms, are more likely to attain a state of procurement alignment”, see Figure 1. The company whose IT strategy is discussed in this paper has the relevant structure and size to achieve success.
2.2. Methodology of Research Based on Construction Company Needs

Proper academic research should produce scientific knowledge, mainly to describe, understand, and predict phenomena of a research field. As it is clearly stated in reference [13] there is also an alternative: to research a number of different solutions to solve real problems in the specific academic field. The aim is to establish an appropriate link between theory and practice, to strengthen the need for academic research. We used the second approach, according to Rocha C.D. [13]. This practical research could be highlighted as follows:

- Describing the problem—how to develop IT procedures according to the needs of a construction company and its clients, avoiding unnecessary disruptions (according to the Disruptive Management Rules);
- Describing the IT state of the company, relevant for different construction processes;
- Interviewing the middle management staff responsible for all processes performed by the company. During interviews, the possible directions and paths for IT development were discussed;
- Summarizing the interviews and checking consistency with the general strategy of the company;
- Creating assumptions for IT strategy development, together with a “user’s manual” for the company’s staff [14]; and
- Starting implementation (already started, we plan to prepare a second part of the article in future with results of implementation, as sometimes required [13]).

A literature review shows also that research should be consistent with prior literature, it should provide a nominal process model for the research results, and it would provide a mental model for presenting research in IT [15]. The process should include six steps. We concentrated on the first four steps—(1) problem identification and motivation, (2) objectives for a solution, (3) design, and (4) development—leaving steps (5) evaluation, and—partially—(6) communication for future description.

The general subject of the research is how middle management staff of a typical large construction company, representing departments and dealing with particular business processes—e.g., bidding, construction execution, BIM (Building Information Modeling), procurement, accounting, controlling,
risk management, treasury, and HR—perceive the status of IT in their area of responsibility. The interviews with employees were supported by previous research on information technology and business processes in the company based on existing company documents. The aim of the research was to develop an IT concept for a large construction company based on the collected data on information technology used in business processes, the state of interfaces between processes, missing elements, and development opportunities in the field of IT.

The presented research problem seeks an answer to the question of how to implement new IT technologies in order to develop better communication within the company and operations. The research method used was in the form of a series of personal interviews (nine interviewees—department directors, meetings with detailed minutes). The interviews were based on the presentation of previously collected information in the form of tables regarding business processes from the company’s internal knowledge base, discussing it with representatives and conducting a survey based on the following questions:

1. What are your main IT-related processes?
2. Where do you see improvements? Are there gaps or overlapping elements in IT systems?
3. Are there information flows between the processes? Are they correct?
4. What are the interfaces with other processes? Is there an additional demand to define interfaces and information flows between processes?
5. Do you see any elements that still need improvement/implementation?

After the interviews, existing process tables were updated where necessary (as shown in Section 3) and a statement showing the use of software in relation to the existing processes in the company was generated. Subsequently, a gap analysis was conducted, and conclusions were formulated concerning the need for changes, improvement, and proper software use (as explained in Sections 4 and 5).

2.3. IT Strategy

The IT strategy describes the assumptions of using IT solutions in such a way that they effectively help to achieve the enterprise’s business objectives and, as such, renew the organizational structure. Efficiency is of importance, i.e., the strategy must be in accordance with the expectations of IT system users, and without excessive delays and unexpected costs [16].

A good digital strategy anticipates the development of the company for the future, setting an action plan and objectives in the long term, while being flexible enough to accommodate unexpected changes in the online space. Of importance is that enough time must be given to implement something strategic.

The conceptual strategy pyramid (Figure 2) is annotated with descriptive information and alignment arrows. It depicts the framework used to develop the IT strategy [17] based on the general company’s strategy.
2.4. Process to Derive the IT Strategy

Figure 3 describes the general approach for developing the main business strategy and the functional IT strategies as derivatives. The main superordinate goal of the business is maintaining its profitability targets in line with adequate quality of its products, reliable scheduling, execution performance (timing), and maintaining a healthy and safe environment for the workforce.

A prerequisite for developing functional IT strategies is the definition of the main business and administration processes, which form a major part of the business model. Of further essence is carrying out a comprehensive IT infrastructure (hardware, software, network) analysis and develop sub-strategies for digitalization of project execution with key construction site processes like BIM [18], scheduling, CAD, and other related IT applications. In the next step to be carried out is defining the collaboration tools and developing and implementing adequate communication and reporting with business intelligence (BI) systems. Further, high importance is given to data security in order to make the systems stable and safe against internal and external impacts. Changing environments, development of new technologies, new business drivers, and trends should be carefully observed and the IT strategy reviewed and updated when needed.
2.5. Definition of Main Business Processes

The business process shows the work and data flows in the business. Management processes can be divided into strategy management and operational management, which consists of market, health and safety, organization, resources, quality, costs, revenues, cash, and risk management. From the perspective of a construction company, the construction process consists of two main stages: the offer preparation process and the construction process. At the offer preparation stage, the processes related to procurement and project estimation, as well as negotiations and conclusion of contracts, are the main contributors. The construction stage, on the other hand, relates to the preparation of project implementation, project management, and project supervision. In a large construction company, the entire process is supported by controlling and reporting, financial and tax accounting, procurement, HR, legal departments, risk management, communication, IT compliance, and security.

Figure 4 presents an overview of the main business and supporting processes, which are usually documented in the company’s quality management (QM) systems. A core element for developing the IT strategy is analyzing the processes separately regarding their deployment of IT tools and at a later stage derive to interactions in order to find room for improvements.
3. Software and Hardware Systems

A typical construction company maintains a comprehensive software and hardware landscape including IT network (LAN/WAN) in order to serve their business needs. In the following, a general overview of software applications will be presented (Figure 5).

![Diagram of software applications](Image)

**Figure 5.** General overview: software applications [own source]. (SAF-T—Standard Audit File for Tax).

3.1. Software Systems

The system landscape of a typical construction company can be divided into four main areas: general office software, engineering software, business support software, and business software. A schematic representation of the system landscape with the general direction of processes and information flow is shown in Figure 5. The office software is available to all employees; in most companies, it is Office 365. The engineering software consists of systems related to project estimation, scheduling, and construction and bidding process support (BIM, AutoCAD).

Business support software includes all software supporting public procurement, software checking business processes and documents from the legal and compliance perspective, and an internal database. Financial software is currently the most developed, with enterprise resource planning (ERP) systems at its core to support HR, accounting, treasury, controlling, and financial reporting processes. These systems have their own functions, or are supported in the form of modules, overlays and additional applications for accounting and tax reporting, and legally required financial procedures.

3.1.1. Construction Estimation and Site Applications

Generally for project estimation market available software is deployed, supported by MS Office products such as MS Project, SharePoint, Excel, and Word.

In Poland, NORMA PLUS software packages are widely used for specific Polish tenders, mainly for public clients that require a specific Polish cost data structure (called in Polish KNR—specification system showing labor, equipment, and materials consumption for particular construction works [19]).

Construction project scheduling is supported with Microsoft Project and PRIMAVERA. Computer-aided design (AutoCAD) and drawing software is widely used in estimation departments and construction sites.

In tendering, BIM (REVIT and ArchiCAD) can be used for quantification, collision detection, and visualization, and on construction sites, BIM software can be used for collision detection, visualization of construction schedules, and quantification of work in progress. Examples for use of additional BIM support are TEKLA BIM site, Solibri Office, BIM Collab, Navisworks, Asta Powerproject, Autodesk Workflows Package, BCF Manager, BIM 360+, etc.
3.1.2. Main Business Software

ERP applications, such as SAP R/3, Navision, SAGE, and others, are standards. These software packages are usually module-based with modules for general ledger accounting, controlling, procurement, fixed asset accounting, etc. These software packages must be tailored to business processes. Modern packages are highly integrated and linked to various other business applications. In larger companies, e-accounting is in use, which is an electronic system for processing accounting documents from the moment of receipt of an invoice to the moment of its payment. It ensures avoiding long paper processing times and transport routes, providing access to up-to-date information on the status of the received invoice, including order value control.

Procurement uses external and internal databases for placing and evaluating subcontractors’ offers and electronic purchasing platforms, catalog applications, and, on occasion, e-auctioning.

Supporting systems for finance and accounting are used for tax accounting, sometimes with add-ons for Poland’s newly introduced split payments (subject to the Polish VAT Act), SAF-T (aimed at monthly reporting of balance sheet data of tax significance (paid accounts, fixed assets, inventory) according to the SAF-T standard), and Biała Lista (White List—an IT solution supporting the control of business partners required by Polish law).

3.1.3. Reporting and Controlling

Monthly business reporting employs reports providing information on branch costs, existing projects and target projects with actual monthly data, forecasts, planning data, opportunities and risks and reports that complement key data, guarantee volumes, and branch balance sheet aggregations.

Usually controlling reports are in-house developments, in cases based on market available software packages, tailored to the specific needs.

3.1.4. Legal and Corporate Compliance, Intranet

Legal and corporate compliance issues can be supported by legal information systems available on the market. In many cases, companies employ intranet solutions containing materials such as company guidelines, press releases, internal letter, trainings, access to portals, etc.

3.1.5. Office Software

Windows Office 365 is the main business software for companies offered by Microsoft generally as a subscription service in the cloud (cloud licensing model). It can include Exchange server (e-mail), main office software (MS Word, MS PowerPoint, MS Excel, etc.) and collaboration tools (MS Teams, MS Project Online, OneDrive, MS SharePoint, etc.).

Microsoft SharePoint (online and server versions in use) can support to “create” data storage team sites and helps in working with others to search for information and files, allowing the configuration and automation of many processes.

3.1.6. Security Systems and Backup Software

There are several data security systems available on the market, which are permanently updated to provide up to date threat protection. In addition, special software can be installed to protect the network with a firewall and provide secure VPN connections.

3.2. Hardware Architecture

In general, today hybrid architectures are used with on-premise servers and cloud applications, such as MS O365 via MS Cloud. The on-premise servers, cloud servers, and end users are connected via cable links of sufficient capacity and, in some cases, radio lines for remote locations.
4. Formulation of IT Strategy

The goal was to formulate a pragmatic strategy complementing the current business model and to make efficient use of the current IT discussed company landscape as a “cloud based organization with new technology orientated systems supporting the business model hindsight optimized site and administrative services, supporting all needs of communication and data exchange, provide efficient reporting, and hence improve result and competitiveness”, as it is stated, at the moment, in the company documents.

The main areas of attention/elements of the strategy were:

- Construction site applications
- General IT support systems
- IT infrastructure/cloud services
- Business intelligence and reporting tools
- IT security
- IT team

4.1. Construction Site Applications—Improvement of Site Processes as Main Focus

- Intensifying introduction of Building Information Modeling (BIM) with ArchiCAD/Revit, and other programs as main BIM tools with some additional applications (Solibri Model Checker, Simple BIM, MEP Modeler, etc.).
- Cloud-based infrastructure with SharePoint as a possible collaboration tool and use of the Microsoft network licensing model.

4.2. ERP/Back Office Systems

- Review the efficiency of ERP systems in terms of accounting, procurement, and other application support.
- Provide workflow systems like SharePoint Online or Teams.
- For larger organization, after careful review, document management systems.

4.3. Mobile Office and Communication

- Employ predominantly mobile telephone systems with internet-based communication and conferencing with MS Teams.
- Install virtual space for sites and provide always secure remote access.

4.4. Reporting Tools/Business Intelligence

- Development of Power BI in order to complement the reporting system.

4.5. IT Team/IT Support

- Build internal IT development team for any new systems (SharePoint, WWW–World Wide Web, etc.).
- Train high-knowledge administrators and provide flexibility of work (remote work).
- IT team to orientate on project site applications.

4.6. IT Infrastructure

- Server systems to move to cloud (MS Azure, MS O365) with MS Azure, main servers environment and minimum of on-premise servers with clear governing of cloud services, thus, realizing highest data protection environment. Constant user alerts and specific trainings to be provided. Cloud backups are envisaged to guarantee full data protection.
• Provide a network, with proper remote connection capacity (construction site locations). Increasing firewall capacity/change from “device”- to “virtual”-based, project sites connected via fiber connection (if possible).
• Focus on a minimum of front-end models, use of standard office computers, and more powerful computers for 3D drawing/reading and BIM computers, second graphic card).

4.7. Other
• Provide sufficient, general trainings in all aspects of IT use and continuous security trainings for team and strengthening user acceptance.
• Identification of new developments in data technology/improvement process to the complement business model.

5. Formulation of IT Sub-Strategies
5.1. Strategy Creation
The management of a construction project is a highly demanding challenge comprised of a range of tasks. The scope of duties expands with the complexity of construction projects. The more detailed structuring there is within the projects, the more the amount of data rises. Tools are needed to store and process the information accumulated. To ensure an effective technical, economic, and organizational construction project, the project management and its instruments are responsible for the following assignments:
• Coordination of processes, including communication issues;
• Documentation, including “post-project as-built” documents;
• Controlling;
• Business intelligence (Power BI); and
• Data security, including the General Data Protection Regulation (GDPR).

Coordination, documentation, and controlling are closely related to each other. Software tools for project management have to take account of the associated joint data use. Only by exchanging data between the tools as well as with other applications, such as design or tender software, can effective processing of the data be ensured. Clear interfaces reduce unnecessary data collection and prevent inconsistent conclusions.

5.2. Strategy Implementation and Trainings
There is currently no suitable, single software that can deal with all the tasks involved in project management of construction companies. The most important types of project management software for dealing with complex, unpredictable, and non-repetitive construction projects are given below:
• Scheduling software—Construction scheduling software is applied to plan, monitor, and control project progress. Relevant software, always when possible online versions, are planned to be used in accordance with the software required by the tradition of the country of operations or client requirements. Software like Primavera, MS Project, and Open Plan which have similar functionality are under consideration.
• Project communication system—Project communication systems support the coordination of a construction project by providing a joint platform (so-called PSWS [20]—project-specific website, Figure 6) to all project members for cooperation and the exchange of information, especially for large, internationally organized projects. Platforms like BIM 360+ or Fusion seem to be proper solutions.
• Digital construction diary (DCD)—By integrating media such as photo documentation [21], the preparation time for creation of the construction diary can be decreased, and common understanding of supervisors’ decisions increased. Furthermore, DCD, supported by pictures from the site, illustrates the current state of the construction project, and, thus, proves especially useful for remote project members.

• Cost controlling software—Cost controlling software is based on capacity planning methods and instruments. Resources are, thus, assessed according to cost information, such as charge out rates of workers, materials, and equipment. Software has to be properly chosen, in relevance of the country of company operations.

• Business intelligence software—Allowing all company staff to increase analytics capabilities with BI Power (AZURE easy access; big data; supply chain, Excel integration, stream analytics in real-time, Figure 7).

• Data protection software—Data protection software enables timely, reliable, and secure backup of data from a host device to a destination device. It is designed to provide data backup and integrity and security for data backups that are in motion, for daily use or at rest, as archives of the company. The issue of the size of gathered data has to be under detailed consideration. The General Data Protection Regulation (GDPR) is also a very important issue related to protection of personal data of company personnel, subcontractors, clients, etc. Existing software for this purpose should allow for safe document storage, backup, and control, reporting to relevant authorities. One type of software available to be considered is Kapio Cloud [22].
6. Summary and Conclusions

ICT (information and communication technology) plays a more and more important and efficient role in project communication. Telecom and communication equipment/devices in a construction project should be sufficient, redundant, backed-up, and reliable, and as advanced as possible. Computers, servers, and routers used on construction sites, document control, and project management should be powerful, durable, and sufficient to handle a lot of information coming in at the same time. They should also be ready for satellite-leased lines in contingency. For very big projects or trans-country/trans-border construction projects, an intermediate server and/or share-point is required and a share-archive is recommended for convenience and helpful for inter-communication.

6.1. BIM (Building Information Modeling)

- BIM is definitely the hottest construction technology trend. It provides an open and highly collaborative economic data system. BIM technology could be the catalyst for a fundamental change to manage, design, and develop a construction project and increase productivity in construction to a large extent [24].
- From a general point of view, BIM will bring more accuracy to the building process and empower the exchange of important project information between the numerous stakeholders of a project. In addition, its further evolution is anticipated to make construction projects more productive and affordable by including sustainability and safety measures [25,26].
- Generally, it is expected that the introduction of BIM technology will increase rapidly during the next years as more and more designers, developers, and contractors use this technology. In addition, public clients demand increased use of this technology in their projects.
- The main benefits of BIM are [26]:
  - Elimination of planning and execution mistakes (conflicts and inconsistencies can be identified, and omissions can be detected and properly managed);
  - Generation of 3D MEP plans during execution can produce efficiency gains when implementing work packages on site;
  - Improved sequencing through visualization enables all work packages to achieve shorter project execution times;
- Improved procurement with better specifications and accurate quantity take-off (QTOs) for procurement packages to generate substantial cost reductions; and
- Overall performance/progress control and, more specifically, improved control of subcontractors' works during project execution in terms of completeness, time, and quality.

- Generally, application of BIM is still at an entrance level, which is due to low margins (including clients are not willing to pay for the use of this technology), traditional business model, acceptance levels on sites and limited skills of personnel, though a strong increase in external/client requirements are noted, giving an additional drive for BIM rollouts and intensifying BIM use.
- A very important element is the intense training of staff to improve the use of current systems.

6.2. Main Business Software Supporting Finance and Accounting
- In general, ERP systems in use are comprehensive, highly integrated, and efficient, but fairly costly requiring a high amount of specialist knowledge. Further systems integration is to be sought.
- There will be a large increase in data generation and new implementation of supporting systems for legally required tax reporting (e-tax submission, Biala Lista, SAF-T reporting, split payments replacing reverse charge mechanism) in the recent (three to four) years to be implemented.

6.3. Controlling
- Controlling systems generally require large maintenance efforts and time-consuming data input. Highly skilled personnel should be maintained on-site to perform these tasks.
- There has been limited use of business intelligence (BI); a further rollout of this concept could support daily and frequent ad-hoc reporting.
- SharePoint use is spreading widely in the enterprise, supporting the needs of data sharing. Here further trainings are needed.

6.4. Office Software (Mainly Microsoft Products)
- The extensive offerings of MS Office software are costly, but provide effective management with an MS license agreement. There is a necessity to use MS software (MS monopoly position).
- Improved user trainings are to be provided to increase the efficiency of the use of MS Office packages. One proposal is the preparation of user information sheets for staff.

6.5. Security Systems and Backup Software
- There is a need to maintain security in permanent focus; constant updates and development of systems are necessary. Deployment of top market software for security and backup furnishes constant updates of company system protection.
- Constant training of user alertness is a must.

6.6. Server Structure/Cloud Services
- The new way of working is sharing data, therefore, cloud services are to be in increased demand. However, it has to be considered that once moving to the cloud, there is no way back.
- On-premise servers will reduce deployment; a hybrid service is necessary to be maintained.
- Azure and Office 365 clouds, serving business necessities, are contemporary modern approaches to use. However, careful cost evaluation is to be carried out.

6.7. Other Hardware/Front Ends
- Mainly desktops and laptops with installed software for flexibility of external use (remote work) will be used which is important in case there are no network connections available.
- Focus on mobile phone services, waiving landlines systems avoiding maintenance costs.
• Adequate conferencing equipment enhances the communication of remote and dispersed interdisciplinary teams.
• Home office/telework possibilities with a steady increase of usage are expected with a flexible network (VPN) connection required.

6.8. IT Team
• The local IT team manages the software and hardware systems, which includes user help/support functions, maintenance and systems updates, and managing licensing agreements. Local team services are seen as more efficient and cost-effective than the use of external services.

6.9. Trainings
• Intensifying comprehensive trainings in IT use is seen as very important to promote digitalization in this conservative business environment.
• It can be said that the COVID-19 crisis promotes the efficient use of digital technology to a large extent, forcing staff to remote work and intensified use of digital communication technology.

6.10. General Conclusion on IT Innovation
• A successful digitalization strategy must involve a re-think of the organizational structure, with flat hierarchies and interdisciplinary cooperation through the company:
  ○ Employees must be heard and included in the reforms, i.e., BIM and other digitization should, in certain cases, be developed from the bottom up as part of an evolutionary process. Specialist staff working with BIM will be the main drivers of the process.
  ○ There should be a creation of separate innovation units to develop new ideas in a “protected space”.
  ○ The trial and error method should be accepted rather than the “perfectionist” approach.
  ○ Digitization requires strong partnering concepts.
  ○ Companies must maintain contact with the client to demonstrate how customer service quality has improved.
• Digital innovation, yes, but not digital only. This means that traditional structures should not be destroyed because digitization works best if both worlds, i.e., the old and new way of business, can be connected. In other words, new technologies only make sense when the capabilities of the existing ones are exhausted. The potential of the current solutions, therefore, needs to be exploited to the full before moving onto something new. It is possible to put together teams of young computer literate engineers and older, more experienced professionals and, thereby, release new potential [26].

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