The Effects of Industry 4.0 Integration for Improvement in Project Communication

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Abstract

The emergence of 4IR, otherwise known as Industry 4.0, has introduced new communication technologies focusing on automation, digitalisation, and the global use of information. As a result, this is drastically changing the process of communication in project management. This article offers an exploration of Industry 4.0 concepts and technologies, and their impact on communications in projects. Firstly, 38 relevant studies have been identified. Then, a review has been conducted to identify the effects of Industry 4.0 integration on project communication. It has been determined that Industry 4.0 significantly impacts project communication. The results of this study also revealed that Industry 4.0 has contributed to the improvement of communication systems of projects, which highly affects the completion of a project. In addition, it was discovered that technological advancements are used to improve landscape communication. Finally, the deployment of Industry 4.0-based tools facilitates communication in project management and leads to greater efficiency through digitalisation and the integration of new technologies. The results of this study are intended to guide the project managers and contribute to the field of project management and Industry 4.0.

Keywords
Industry 4.0, Project communication, Project management, project.

1. Introduction

Industry 4.0 is drastically changing the process of communication in project management, as new communication technologies are being invented. People are now obliged to use high technology appliances, rapidly becoming the most dominant influence in their working life. Industry 4.0 is the contemporary phase in the industrial revolution, focusing on automation, digitalization, and extensive use of communication and information technologies in the global business environment (Alaloul et al. 2020).

Previously, communication within a project was done by project management software, instant messaging, blogs, telephone, fax machines, email groupware, teleconferencing systems as well as word processors (Pitagorsky 1998). Industry 4.0 came with new smart systems that enhance project communication. These systems include advanced modern sensing, teams integrating physical industrial components, and networking technologies (Gungor 2019).

The main objectives of project communication include guaranteeing timely generation, storing collection, and disseminating project information. Project communication has been defined as an exchange of information and knowledge from different points within the project (Rajkumar 2010). In addition, through communication, project team members can collaborate, integrate and share information and knowledge to meet project objectives (Zulch 2014).

1.1. Problem statement

Poor communication often leads to a project not meeting its intended goals and objectives, which results in customers' dissatisfaction as their needs and expectations are not met (Mesa et al. 2016; Wu et al. 2017; Durdyev and Hosseini, 2020). This may cause a significant loss for the organisation doing the project, since it may not be considered for future projects (Discenza and Forman 2007).

Communication in each stage of the project is key to a successful project (Le Bui Ngoc 2019). Therefore, industry 4.0 systems help the project team effectively link the areas of cost, scope, time, and quality through communication. The industrial revolution needs the leadership to balance innovation and chaos with organizational processes' solidity. Leadership is no longer about tittles but more about organic collaborative processes. This enhances communication

and collaboration between project management and leadership roles to overlap and draw on shared knowledge to mitigate the policies of the organization (Bolick, 2019). This is a prelude to achieving the project's strategic intent.

1.2. Aim, objective, and research question

The aim of this study is to explore the implementation of an effective industry 4.0 system, and its impact on project communication.

- ***Research objective:*** To explore the integration of Industry 4.0 concepts and technologies, and their impact on communication in projects, through a review of relevant previous studies.
- ***Research question:*** What are the effects of integrating Industry 4.0 in projects?

1.3. Scope of the study

This research is based on the impact of Industry 4.0's integration on project communication. As construction technology is already extremely developed (Begić et al. 2022), communication management is significantly important not only for converging and incorporating technology (Industry 4.0) but also for enabling the clear and effective communication of stakeholder views within project teams (Zulch 2016).

1.4. Significance of the study

This study contributes to the body knowledge of project management and Industry 4.0. Having greater insight into the impact of Industry 4.0 on project management communication would yield useful information about effective project management practices. In addition, this study provides valuable implications for the construction industry, particularly, on how construction project teams should engage formally in managing the communication process by the use of appropriate project management tools and techniques.

2. Methodology

Reviewing the literature is an important part of academic research. In principle, the advancement of knowledge must be based on previous work. It is important to know where the knowledge frontier is to drive it forward. A better understanding of the breadth and depth of the existing body of work by evaluating relevant literature and identifying gaps to investigate can be gained (Xiao and Watson, 2019). This review was conducted in three phases, the first phase refers to planning the review, the second is conducting the review, and the third phase is reporting the results (Figure 1):

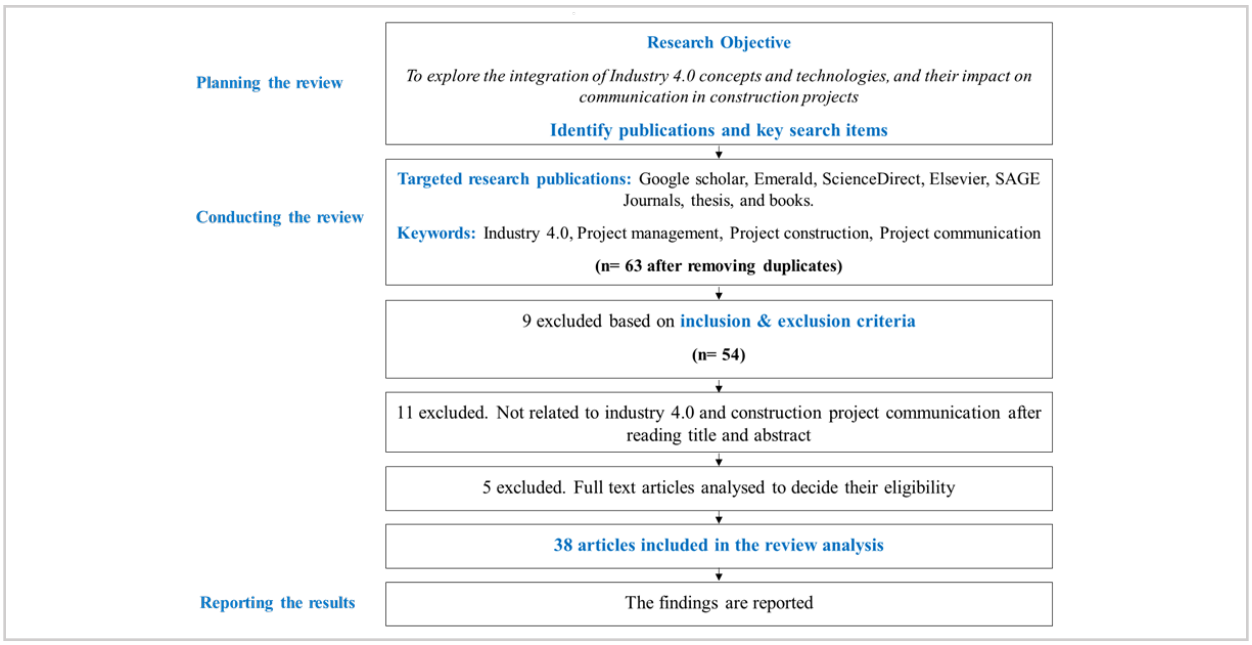

Figure 1. Review process of the current study (Source: Authors).

The inclusion and exclusion criteria (Table 1) were applied in the process of data search to acquire the relevant literature:

Table 1. Inclusion and exclusion criteria research gap

Inclusion criteria	**Exclusion criteria**
Research written in English.	Non-English research.
Publications from 2014 - 2021	Publication before 2014
Research relevant to the topic.	Research not relevant to the topic.
Research that focuses primarily on Industry 4.0 and project communication	-

1.5. Planning

The research objective as specified in the first section and appropriate databases were selected. The authors decided on which keywords to use to search for relevant studies. Before commencing the Review Process, three factors were taken into consideration: (a) based on the resear*ch objective*, which keywords should be used, (b) in terms of the field of publication, how and which keywords should be used in the review process and (c) how many articles will be obtained (Henrique and Godinho Filho 2002).

For this review process, the authors considered studies (Including books) that were published from 2014 to 2021 and selected the following renowned databases: Google scholar, Emerald, ScienceDirect, Elsevier, and SAGE Journals. The authors merged the following terms for the search criteria: 'Industry 4.0', 'project management, 'project construction', 'project communication'. When selecting the relevant publications, only the ones published in English. Off-topic studies were removed, such as studies that did not focus on aspects of industry 4.0 in project communication.

1.6. Conducting the review

From the selected databases, after removing duplicates, 63 research were captured. After the inclusion and exclusion criteria were applied, 54 research remained. Then the title, abstract, and full-text analysis were implemented. 38 Research were retained and included in the review analysis of this study.

1.7. Reporting of results

The aim of this study involves examining the implementation of an effective industry 4.0 system, and its impact on project communication. It was decided to identify the patterns, directions, similarities, and differences in key elements within the sampled publications. The third phase will be covered in the following sections where the articles are examined and analysed in depth. During this phase, the homogenisation of data was considered to improve the consistency and integrity of the review.

3. Results of the review

3.1. Industry 4.0

The foundation of Industry 4.0 is technological advancements, advances in the field of Information and Communication Technologies (ICT) systems, and the internet-based linking of whole value chains (Kagermann, 2015). Cyber-physical systems (CPS), which include sensors, microprocessors, and actuators, are at the heart of Industry 4.0, allowing for real-time data (Müller, Buliga, and Voigt, 2018). Industry 4.0 has had a huge impact on how businesses and organizations operate in the twenty-first century. It's an overall word that encompasses a wide range of cutting-edge technologies, from cyber-physical systems (CPS) and big data analytics to the Internet of Things, 3D printing, and cloud computing. These cutting-edge technologies result in a one-of-a-kind change in this value chain under the umbrella of Industry 4.0 (Zhou et al. 2015). Several academics have proposed explanations for Industry 4.0 (Safar, Sopko, Dancakova and Woschank, 2020). A study conducted using advanced ICT in the industry helps to improve manufacturing efficiency and competency (Xu, Xu, and Li, 2018). In the literature on Industry 4.0, there appears to be widespread consensus that it will increase customer experience, efficiency, and production (Chen et al. 2017; Imran 2018). Furthermore, Industry 4.0 will improve agility and adaptability, resulting in a significant rise in profitability.

3.2. Importance of communication in Construction Project Industries

The foundation and starting point of all activities in the construction project management industry is communication. The application of poor communication skills in construction project management leads to project results that do not

meet project objectives. The lack of an appropriate model of communication skills for project management can contribute to ineffective project communication. Therefore, it is important to define communication lines, channels, levels, and information management methods at the beginning of a project (Zulch 2016). It is estimated that project managers and project team members spend around 90% of their work time engaging in some form of communication (Zulch 2016; Burke 2010).

3.3. Industry 4.0 in Project Management

In the current era, identifying the relevant components of Industry 4.0 and aligning with its requirements is imperative for a business's survival and competitiveness. The importance of project management in the realization of business objectives increases day by day, especially since every project in the industry has some uniqueness. In this sense, the effects of Industry 4.0 reflect an era characterised by technological applications that are breaking new ground in many areas. The impact of Industry 4.0 is felt in various industries. The composition of future project teams also will drastically change with the introduction of artificially intelligent robots as team members. Future project teams will contain both humans and nonhumans as organizations' internal and external landscapes are getting more connected during the fourth Industrial Revolution (Marnewick and Marnewick 2019).

Industry 4.0 is a strategic initiative that aims to change manufacturing through digitization and the use of new technologies (Rojko, 2017). The digitisation and the characterisation of all of the assumptions, methodologies, and processes of the Industry 4.0 can cause disruptive effects on traditional project management and the role of the project manager. This new paradigm necessitates more active project management, as well as new technical, contextual, and behavioral skills. To accomplish this task, the most relevant concepts that are associated with industry 4.0 and with the project manager competencies are presented (Ribeiro et al. 2021).

Industry 4.0 is an initiative driving fourth the economic revolution, which is occurring at an exponential rate. Embracing and adopting Industry 4.0 is inevitable for survival and operational excellence. Although significant progress has been achieved in the adoption of Industry 4.0 technologies, systems, and processes in developed nations, there is ambiguity about the readiness of businesses and industries in developing countries, such as South Africa, to adopt 4.0 (Maisiri and van Dyk 2019).

3.4. Integration of industry 4.0 in project communication

The influence of technological factors, which are among environmental factors, on the production system is increasing day by day. Furthermore, today, adaptation to factors should be ensured for building products to achieve success by ensuring ecological, social, and economic sustainability. However, problems that arise in the traditional project management process and cannot be solved, negatively affect quality, time, and cost. Also, it is thought that various technologies brought by Industry 4.0 will bring radical change to the project management system. In addition, Industry 4.0 technologies will bring real-time solutions to the problems in traditional project management. In this direction, Industry 4.0 technologies need to cover all concepts in project management (Taner and biçer 2020).

As the world enters the Fourth Industrial Revolution of computerized reasoning, mechanical technology, and the web of things, the test for Africa is furnishing its youth with the information and abilities required for the arising universe of work. Sub-Saharan Africa (SSA) should make rapid progress in exploiting fortunate breaks and overcoming challenges. This upheaval will influence occupations in all areas, however in stages and to various degrees. Africa Will not be computerised instantly, yet the coming worldwide effect of 4IR makes more pressing the monetary change SSA currently needs to augment its benefits and understand its latent capacity (Ayentimi and Burgess 2019).

A study shows that difficulties and openings headed to Africa are its way to deal with the fate of work needs, in any case, current real factors. These incorporate "jobless development", foundation shortfalls, restricted utilization of current innovation, and a labour force that is more than 80% dynamic in the casual area, with women overrepresented (Sutherland 2020).

The way to introduce Industry 4.0 to Africa's latent capacity is through superior teaching and training, and a more exceptionally talented labour force (Ndung'u and Signe 2020). In addition, an accentuation of ICT abilities and basic thinking from the essential level onwards (Mhlanga and Moloi 2020).

The Fourth Industrial Revolution (4IR) addresses another period of advancement in innovation – one that is upgrading human-machine connections, opening new markets, and energizing development across the worldwide economy (Mkansi and Landman 2021). n South Africa for example, different gatherings are advancing the Industry 4.0 and finding a way to use it (Kademeteme and Twinomurinzi 2019).

In 2020, South Africa was positioned 59th out of 63 economies in the Institute for Management Development's (IMD) World Competitiveness Yearbook – its least positioning since the origin of the yearbook. Its general top shortcomings were recorded as advanced and mechanical abilities, just as advanced education achievement (Naudé, 2017). South Africa has successfully initiated a plan to migrate to the innovative changes carried out across different industries. Straightforward usefulness upgrades, 4IR advancements have also turned into an indication of expectations in South Africa's formative and social discussion (Kademeteme and Twinomurinzi 2019).

3.5. Effects of Industry 4.0 in project communication

Internet of Things (IoT), Big data, simulation, autonomous robotics, additive manufacturing, augmented reality (AR), cybersecurity, cloud computing, and system integration are some of the technologies deployed in the execution of Industry 4.0, and they have a massive impact on project communication (Moktadir Ali et al. 2018). Industry 4.0, which is based on digitalization, automation, and interconnection, signifies a paradigm shift driving the contemporary industrial revolution (Liao et al. 2017). Its purpose is to connect resources, information, things, and people in the generation of industrial value (Kagermann 2015).

Industry 4.0 in project communication facilitates data interchange and analysis, resulting in multiple benefits for all supply chain participants as well as the client. Better process alignment across the supply chain, for example, can result in enhanced resource efficiency in terms of material usage, energy consumption, and waste processing, resulting in cost savings and productivity gains (Müller et al. 2018).

The principal changes in project management in the communication management area for industry 4.0 projects have been identified as follows (Müller 2021; Simion et al. 2018):

- Accelerating communication processes within projects;
- Removing physical communication support and increasing connectivity;
- Use of human-machine and machine-machine communication in the execution of projects;
- Less time spent on progress reports;
- And Auto-generation of progress reports.

Finally, research revealed that the effect of Industry 4.0 on project management has been primarily observed in seven key components of project management such as time management; cost management, quality management, project team management, communication management, project risk management, procurement, and resource management (Simion et al. 2018).

4. Findings of the study

The most recently profound transformation in the nature of humankind has been identified as the evolution and upgrade of technology (Daniel and Devi 2019). The integration of projects and Industry 4.0 has fundamentally created a space of project communication and the application that has risen due to the 4th industrial revolution. A common example of this has been observed in how the project team will communicate by devices such as a cell phone or laptop and the utilization of the project's components in terms of logistics. The following goals were identified as the crucial points to have influenced the study and revolution in project communication and the 4th industrial revolution:

- Maximize the comprehension and speed of the project in the multi-faced impact of technology.
- Design the framework of thinking about the revolution of projects that outlines major issues and highlights possible solutions.
- Initiate partners.
- Primary provider of the public and private sectors in quality project management.

Industry 4.0 has a major impact on the communication system of projects. In fact, communication methods had expanded considerably in the entire construction industry and team members from all over the world will be able to work on the same projects (Newman et al. 2020).

Industry 4.0 has innovated the factors of adjusting and providing project communication in a more efficient manner when applied effectively. One of the spotted bridges that have magnificently allowed access to the fourth industrial revolution with the project communication is what is called the Internet of things (IoT) which is described as the relationship of what is referred to as things that can be locations, processes, products or services to name a few, and or with people that are made possible by connected technologies and various platforms (Boyes et al. 2018). Various means of providing connection to things in a physical world to virtual networks are excelling at an outstanding pace (Khanna and Kaur 2019)

The review analysis of the effects of integrating Industry 4.0 on project communication in the building industry has been summarized in Table 2 (Taner and Bicer 2020). The findings were based on the following project management factors (organization and coordination):

Table 2. Findings for the impact of industry 4.0 on project communication in the construction sector.

Factors	***Responsibilities to Take Place in Factors***
Organization	Ability to continually communicate with cloud computing systems of different disciplines.
	Communication of the management team via the internet and technological tools.
Coordination	Ensuring effective communication with simulations and computer-based tools.
	Real-time coordination of project stakeholders' communication with the use of big data and cloud computing systems.
	Efficient communication by using system integration and cloud computing systems.

The following are additional effects of industry 4.0 integration on construction project communication that were identified throughout the review process:

- ICT improves efficiency and competency (Henrique et al. 2020).
- Project objectives are met (Zulch 2016).
- The integration of industry 4.0 enhances project communication (Zulch 2016).
- Industry 40 brings real-time solutions to traditional project communication (Taner et al. 2016).
- Industry 4.0 positively affects the quality, time, and cost of project communication (Taner et al. 2016).
- The use of some Industry 4.0 technologies such as IoT positively impacts project communication (Moktadir et al. 2018).
- Industry 4.0 facilitates data and information interchange and analysis (Müller et al. 2018).
- Industry 4.0 improves process alignment and communication across the supply chain of projects (Müller et al. 2018).
- Although Industry 4.0 can cause disruption of the traditional project communication, it certainly improves a lot of aspects of project communication (Ribeiro et al. 2021)

5. Conclusion and recommendations

This paper aimed to contribute to the integration of Industry 4.0 in project communication. The reviewed literature discovered that Industry 4.0 is a strategic initiative that aims to change project management through digitization and the use of new technologies. The literature review also identified the importance of various factors regarding the integration of Industry 4.0 in Project communication. Based on the literature, communication has been identified as the foundation and starting point of all activities in the construction project management industry. It has been found that poor and ineffective communication or the lack thereof of the application of proper communication skills in construction project management could hinder the progress of the project and lead to a less desirable conclusion the project. The literature also stated that the integration of industry 4.0 in project management could simplify and lead to greater efficiency in project management through digitalization and the introduction of new technologies.

It has been found that the integration of industry 4.0 aims to bring great changes to manufacturing through the introduction of Artificial intelligence technology, which entails the use of robots and other forms of new technologies to help simplify and bring more efficiency into project management. However, the findings revealed through communication project team members can be able to collaborate, Integrate and share information and knowledge to meet project objectives.

Poor communication remains to be the main source that leads to a project not meeting its intended goals and objectives. However, Communication is regarded as the foundation and starting point of all activities in the construction project management industry. At all levels of an organization, effective communication is critical to attaining productivity and sustaining great working relationships.

This study recommends the accompanying techniques to improve communication skills in the organization:

- Labour should be upskilled in new communication technologies used in the organization, and have a sound understanding of how the different organizational structures function to optimize the technological tools.
- Increase labour engagement - It strengthens the bonds between co-workers and creates a more enjoyable working atmosphere.
- It is simpler to establish good workplace communication when you know each other's skills and weaknesses.
- Purposeful direction of communication, and obtaining feedback is a good technique to ensure that no one is left behind.

Further research should focus on assessing the impact of Industry 4.0 on project communication using statistical techniques such regression analysis.

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