Case Study Analysis Of Successful Companies' Use Of Digital Twin To Reduce Waste

Yas Khudhair Abbas [1], Ali Mahdi Hameed [2], Ghufran shallal mohammed [3]
[1-3]AL -Furat AL -Awsat Technical University, Technical Institute of Dewaniya, Iraq,
Email: dw.yas@atu.edu.iq [1]. dw.ali6@atu.edu.iq [2], ghfran.mohamed.idi6@atu.edu.iq [3]

Abstract. The purpose of this research is to build a review study to analyse the situation of successful companies in the use of digital twinning to reduce waste and losses that occur in the lack of accurate investment of time and efforts made, and from this basis was presented a set of previous studies related to digital twinning in order to determine the findings of these studies and discuss them by identifying points of similarity and difference between these studies, And then come up with an idea and a new mechanism to determine the behaviours that companies can pursue in order to apply digital twinning, and on this basis the research discussed the conceptual framework of digital twinning and then the mechanisms through which companies can use it in order to develop their ability to achieve strategic success and competitiveness, the research has come out with several results, foremost of which was that digital twinning works to build a digital model that parallels competing companies through data analysis, improving their efficiency, accelerating innovation, predicting trends, and Then improve the customer experience and achieve integration between the current systems and the systems pursued by other companies.

Keywords: digital twinning, successful companies, competitive advantage, data analysis.

Introduction

In the era of modern technology, the challenges that guide companies are increasing as a result of turbulent changes in the business environment, especially with regard to technology and markets, and with the emergence of new concepts such as digital twinning, it has become necessary to understand how this technology can contribute to the success of companies, and therefore digital twinning is not just a technological tool, but rather an integrated strategy that allows companies to adapt to different processes and systems, which contributes to making data-driven decisions and promoting creativity and innovation.

On the other hand, digital twinning can collect, analyse and then interpret data by providing deep insight into performance and guidance, and thus contribute to improving operational efficiency and supporting the customer experience in managing and participating in the process of designing and innovating new products and services, which generates different scenarios and anticipates results before making decisions, which in turn enhances competitiveness and achieves sustainable success.

Digital twinning also provides an important mechanism for successful companies by directing them in the right way to build digital modelling that represents real-world systems, and this contributes to the collection and analysis of big data in companies, which helps in a better understanding of the products and services provided by these companies, as well as this digital twinning can improve the efficiency of performance by working on simulating processes and systems between different companies in the same industry by identifying and improving

weaknesses and investing opportunities to reduce waste and improve efficiency. Digital twinning can also accelerate innovation by focusing on product development and testing the models and strategies that companies put in place to succeed, reducing risk.

PART ONE: RESEARCH METHODOLOGY

First: Research Problem

In the era of digital transformation, modern technologies and related technologies have become an integral part of accounting business strategies, digital twinning represents one of the innovative pillars through which each company seeks to improve the efficiency of its operations and enhance creativity and innovation, which requires a model that contributes to building virtual copies of assets and operations in the real world, which contributes to the interpretation and analysis of data of all kinds and improve performance, On the number of the many benefits it provides in terms of improving efficiency and reducing costs, most companies face challenges and difficulties by employees to apply the standards required to reach the best performance, and this leads to resistance to change and lack of necessary skills and capabilities, in addition to the high additional cost pursued by the company to build technological infrastructure, so the current research came to focus on the role of digital twinning in achieving success for companies and reducing waste, Thus, the research problem can be formulated into an important question: **"Can companies adopt digital twinning to achieve success in performance and reduce waste?".**

Second: Importance of Research

The importance of research is highlighted in the following points:

1. Digital twinning is an important technology that companies need in the modern era in order to achieve success in their operations and provide the necessary assets in order to reach their goals.

2. Digital twinning contributes to the collection and analysis of data by better understanding the environment and working to make informed decisions that serve to achieve the goals set.

3. Digital twinning improves efficiency by implementing process simulations in a way that weaknesses can be identified and addressed as much as possible, which in turn leads to operational efficiency.

4. Digital twinning allows companies to experiment with new and innovative models and technologies without the need for huge investments that complicate the company's operations and objectives.

Third: Objectives of Research

The main goal and objective of the research is to use digital twinning to achieve success for companies and reduce waste, whilst the other goals that the research seeks to achieve are:

1. Identify the mechanisms and technologies that companies can use in order to achieve success based on digital twinning.

2. Identify the similarities and differences between the previous literature and discuss them as much as possible.

3. Demonstrating the mechanisms through which companies can reduce waste by relying on data analysis based on digital twinning.

4. Directing companies to use digital twinning in order to predict waste and losses before they occur and address them, which determines the period of downtime.

PART TWO: LITERATURE REVIEW

First: The Concept of Digital Twinning

In the era of modern technology, innovative concepts that exercise their role have become important in improving efficiency and enhancing creativity, and among these concepts digital twinning technology has emerged as a powerful tool that contributes to improving the mechanisms and capabilities of institutions to better understand and analyse complex systems, allowing the company to collect real data and digital models and open new horizons for achieving its vision and mission in the long term (Gajdzik & Wolniak, 2022:69), digital twinning can also identify virtual models through which sensors and modern technologies can be built by creating an accurate digital version through which performance can be monitored, data analysis and potential problems can be predicted, and therefore digital twinning can be considered a strategic tool that contributes to improving administrative decisions and developing processes and strategies, as well as enhancing the ability to innovate, making it an essential mechanism in achieving excellence in the information age (Mihai et al., 2022:2256). Digital twinning is a relatively new topic in the built environment (Saeed et al.,2022:686), and digital twinning is defined as a modelling process that is used to build and verify mathematical or digital twinning models on goal building (Yoon&Koo,2023:11), and defined (Collins & Smith,2022:10; Van Su,2023:140) digital twinning as a virtual model (i.e. a digital version) of a system over the life cycle of a system. Pronk et al., 2024:455 argued that digital twinning is

an approach that leads to the meaningful development, implementation and use of various information delivery infrastructures, such as digital. Khalaj et al.,2023:1704 explained that the concept of digital twinning is essential to connect intelligent manufacturing and cyber-physical systems to the virtual world.

Digital twinning is an important strategic technological trend and challenge in the digital transformation of production systems (Kazała et al.,2021:22), digital twinning is a continuous and changing process of representing physical assets in the digital space across a set of dimensions with different levels of complexity (Vieira et al.,2024:160). Geetha et al., 2024:356 noted that digital twinning is a technological technology that aims to create a digital model that represents an object or system through which individuals can build multiple fields in manufacturing, healthcare and smart machinery.

From the above, it can be said that digital twinning represents the outcome of understanding and managing the various systems that allow the company to collect data and digital models and invest them in a way that achieves its goals, which contributes to making informed decisions and achieving new levels of capabilities, competencies and innovation.

Second: Previous Literature Related to Digital Twinning

The previous literature represents a basis for identifying the findings of academic articles, and an overview of them can be presented as follows:

1. Study (Ezz El-Din et al., 2022)

Development is a comprehensive and integrated process, as it has been associated with a huge intellectual and educational transformation that includes all the human, scientific, cultural and technological capabilities employed in the service of sustainable development, and therefore the aim of this study is to study the impact of integrating information and communication technologies in education through digital twinning in order to discover and exploit partnership opportunities, whether in the field of education, training and evaluation, within the framework of international exchange and cooperation in the educational field between the Ministry of National Education and its foreign counterpart, in accordance with the participatory approach and openness to others, in order to Designing and implementing sustainable development plans in the national education sector based on ensuring the quality of education and training and integrating educational partners into the knowledge society, and in order to achieve the United Nations Sustainable Development Goal. The results of the study showed that this partnership achieved the goal of this knowledge integration through the localisation of modern information and communication technologies in the field of education and keeping pace with the rapid development of these technologies and their optimal employment in the Algerian educational

system, and enabling learners to acquire the skills of the twenty-first century, which enable them to create job opportunities and improve their standard of living, and highlights the importance of this partnership in increasing the efficiency of cooperation, communication and partnership between learners themselves and with others at home and abroad on the one hand, and increasing the efficiency of teachers and components of Other hand.

2. Study (Temsah, 2022)

The current research aimed to identify the effectiveness of an electronic training program in Arabic language teaching strategies based on digital twinning to develop teaching competencies and the level of technical enlightenment among Arabic language teachers at the secondary stage, and to achieve the goal of the research, a technological teaching competencies observation card was built, in addition to testing the cognitive dimension of technical enlightenment, and the technical enlightenment scale, and this was applied to a sample of Arabic language teachers at the secondary stage, numbering (thirty) teachers from the schools of the city of Kharga in the New Valley, where The research has taken the experimental design with one group, and the differences between the pre- and post-applications were statistically significant at the level of significance (0.01) in favour of the post-application of the technological teaching competencies observation card, and statistically significant differences between the pre- and post-applications to test the cognitive dimension of technical enlightenment, and the technical enlightenment scale at the level of significance (0.01) in favour of the post-application, This indicates the effectiveness of the electronic programme in developing the teaching competencies and the level of technical enlightenment among Arabic language teachers at the secondary stage, and the research reached a set of recommendations, including: The need to pay attention to electronic training programmes to develop the skills and technological teaching competencies of secondary school teachers.

3. Study (Muhammad, 2023)

The research aimed to study and test the impact of the application of metaverse technology on the practice of operation and maintenance of the asset management system, in addition to studying and testing the modified role of digital twinning technology on this relationship in the Egyptian professional practice environment based on an experimental study on a sample of Egyptian industrial facilities, and the research reached in the theoretical part of the importance of applying metaverse technology as one of the modern digital technologies for artificial intelligence that contribute to improving the operation and maintenance practices of machinery and equipment, and then the transition to smart management. The research also found that the application of metaverse technology in light of the adoption of digital twinning technology

plays an effective role in helping industrial facilities to create a virtual version of machinery and equipment within the facility, and then interact and digitally represent the data of this copy with its physical counterpart in a two-way manner, allowing to improve the performance of the operation and maintenance practices of the asset management system and to improve the quality of production processes, reduce operation and maintenance costs, and improve the risk management process.

The research in the experimental part through the basic analysis on a sample of practitioners found a positive impact of the application of metaverse technology on the operation and maintenance practices of the asset management system, and also found that the impact of the application of metaverse technology in light of the adoption of digital twinning technology was more positive on the practice of operation and maintenance of the asset management system compared to the impact of metaverse technology on the practice of operation and maintenance of the asset management system in light of the non-adoption of digital twinning technology. While the study targeted by conducting an allergy analysis, the results under the sensitivity analysis reached the same results as under the fundamental analysis, which indicates that the results of the sensitivity analysis fully support the results of the fundamental analysis.

4. Study (Fares, 2024)

The study aimed to measure the impact of the audit client's adoption of digital twinning technology on estimating audit risks, and the research relied on the analytical study method for the research sample consisting of four categories: accountants and auditors in major accounting and auditing offices in Egypt, members of the Central Auditing Organization, officials of technological development techniques, accountants and financial managers in a group of companies listed on the Egyptian Stock Exchange according to the EGX 100 index for the purpose of testing the research hypotheses, and the sample vocabulary reached 200 items for the purpose of testing the main hypothesis of the research Which emanates from it 3 sub-hypotheses, and some appropriate statistical methods have been used and applied through the program (SPSS) in analysing the results and testing hypotheses. The research came out with several results, the most important of which is the existence of a significant relationship between the research variables for all sub-hypotheses, which confirms the acceptance of the main hypothesis of this research, Based on that, the researcher recommended a set of recommendations, the most important of which were: The auditors must apply the audit procedures accurately, in order to discover material errors in the financial statements, whether resulting from fraud or error, as the error in the audit procedures may lead to the survival of a material distortion without being discovered by the auditor.

5. Study (Saleh, 2024)

The research aims to study the relationship between the use of digital twinning technology and the rationalisation of internal costs in real estate companies in Egypt, as it seeks to understand how digital twinning can help real estate companies improve the efficiency of their operations and reduce their internal costs. The research relied on the use of the quantitative analytical approach by collecting and analysing quantitative data and providing results that can be interpreted and applied in the field of research as it helps in understanding the relationship between variables by analysing data on study variables using statistical methods and methods such as multiple regression to understand the factors and challenges associated with the use of digital twinning and rationalisation of costs. The research came out with several results, the most important of which is the existence of a relationship between the use of digital twinning and the rationalisation of internal costs in real estate companies in Egypt, and will also provide recommendations on how to adopt digital twinning effectively to achieve cost savings and improve operational efficiency.

6. Study (Haitham, 2024)

The (importance) of the research is to highlight a new technology that will increase the shelf life of products, which is the "digital twin" technology. Reduce the cost of design, testing, and product samples, and reduce the cost of operation. Predict product failures before they occur and reduce the cost of maintenance. Protect the worker when using some dangerous machines. Monitoring the product or system remotely without the need to be next to it, and one of the (objectives) of the research was to develop the method of product maintenance to digital technology "digital twin" because of its great impact in extending the life span of the product, maintaining its safety, improving its performance at work and protecting the user, reducing the costs of each of (design, production, maintenance). Achieve safety in all product tests. Teaching this technique to students of industrial design because of their experience that helps them understand this technique, and implement it in a simplified and uncomplicated way. The most important (results) were the clarification of a new technology for the industrial designer that appeared in the world that will develop the method of product maintenance to digital maintenance first, and clarify the importance of that technology in extending the life span of the product, reducing design, production, maintenance costs, and getting rid of the problem of sudden product stopping during work. Reaching a methodology or stages for digital twinning in the field of industrial design. The (recommendations) were the interest in studying the technology of "digital twinning" because it would facilitate the design and production process, the introduction of this technology to the courses taught by students of the specialisation, the

interest of the industrial designer in the technology of "virtual reality" of all kinds because of its great impact on enriching the design process

7. Study (Al-Haik, 2024)

We cannot prevent a disaster, but we can mitigate its effects by preparing for it and preparing well to confront it, and therefore the research aimed to introduce the importance of digital twinning in the disaster management process for this purpose in light of the earthquake of February 6, 2013 that Syria was exposed to and through the needs that were monitored in the process of addressing this disaster, the digital twinning model was proposed The layers it needs for the process of providing a comprehensive database that enables the decision-maker In the operations room, to take the appropriate decision and accelerate the process of rescuing the stranded, where the contents of this digital twin and the stages of its preparation were identified The benefits that can be obtained by applying this digital twin, whether in the subject of planning or in the subject of disaster management.

PART THREE: DISCUSSION OF PREVIOUS STUDIES

It is clear from the previous literature that has been presented that digital twinning plays an important role in directing companies towards adopting the standard and principle of sustainable development and its impact on the technologies used by the company, which means that development is not just an economic improvement, but includes intellectual, educational and cultural aspects that contribute to achieving development as a multidimensional process, and this shows that the importance of digital twinning between companies contributes to promoting education and exchanging experiences, which means employing information and communication technology in education, and this is what focused He has a study (Ezzedine et al., 2022). On the other hand, the study (Crocodile, 2022) confirms that the effectiveness of e-training programs is designed to improve the strategies followed in any company, and this in turn mainly depends on the twinning pursued by the company, which means that the use of capabilities and purification enlightenment for employees works to enhance and improve the technology that the company is working on in order to keep pace with the rapid changes in the environment.

Studies have also shown that operational practices that rely on asset management adopt digital twinning as one of the modern digital technological tools for artificial intelligence that contribute to building and improving operational and maintenance practices for the technologies used, and this is what was shown by a study (Mohammed, 2023). Fares, 2024 study also focused on the audit customer's use of digital twinning technology to estimate audit

risks by relying on accountants and auditors in developing audit capabilities and applications in the company, and this reduces financial and accounting fraud and reduces fraud and error.

PART FOUR: CONCLUSIONS AND RECOMMENDATIONS

First: Conclusions

1. The results showed that digital twinning works to build a digital model that parallels competing companies by analysing data, improving their efficiency, accelerating innovation and predicting trends, thus improving the customer experience and achieving integration between the current systems and the systems pursued by other companies.

2. The results showed that digital twinning contributes to improving the efficiency of operations by analysing and collecting data in real time in a way that enables companies to identify operations and reduce waste.

3. Companies are keen to anticipate problems before they occur, which contributes to reducing downtime and costly repairs, which helps to optimise the use of resources and reduce waste.

4. Companies are interested in improving the quality of their products by analysing and improving performance, which helps companies to improve the quality of services and products, which reduces waste and defects in providing services and products used.

5. Companies focus on reducing production costs by improving workflows and reducing time spent on operations, which leads to reducing costs and increasing their ability to adapt to changes in demand.

Second: Recommendations

1. Companies should use digital twinning to monitor their actual performance in order to ensure an improvement in the rapid identification of points of turn, allowing data analysis and addressing problems as much as possible.

2. The need for companies to keep pace with the mechanisms of improving manufacturing processes by reducing losses in production processes using process simulation and analysis.

3. The two companies should coordinate between suppliers and customers using digital twinning through supply chain management and product lifecycle analysis to assess the impact of products on the environment during their lifecycle and identify opportunities to reduce waste.

4. The need to focus on the use of resources clearly by stacking energy consumption and resources using digital twinning, as well as training workers using digital twinning to improve their performance and reduce errors.

5. Companies should integrate data from different systems using a comprehensive analysis that helps identify the areas of waste suffered by the sample.

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