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## Examining the Impact of Using Automation and Technological Integration on Work Engagement in SMEs in Egypt

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### Abstract

*the rapid advancement of digital technologies has reshaped organizational processes across the globe, creating new opportunities and challenges for small and medium-sized enterprises (SMEs). In Egypt, SMEs represent a cornerstone of the economy but often face constraints in resources, infrastructure, and human capital that hinder the effective adoption of digital transformation. While much of the existing literature has emphasized financial performance and competitiveness, relatively little attention has been paid to how digital transformation impacts employee-level outcomes such as work engagement—a vital factor for organizational success and sustainability.*

*This research investigates the relationship between Automation and Technological Integration and Work Engagement (WE) in Egyptian SMEs, drawing on the Job Demands–Resources (JD-R) theory as the guiding framework. Specifically, the study examines Automation and Technological Integration on employee vigor, dedication, and absorption at work. A quantitative research design was employed, using survey data collected from SME employees. Statistical analyses, including correlation and regression, were conducted to test the research hypothesis.*

*The findings confirm that Automation and Technological Integration have a significant and positive impact on work engagement, with Automation and Technological Integration showing the strongest explanatory power. These results suggest that digital initiatives not only improve efficiency but also act as critical job resources that enhance employees' motivation, resilience, and immersion in their work. The study contributes to theory by extending JD-R applications to the digital transformation context and to practice by offering actionable recommendations for SME managers and policymakers to implement people-centered digital strategies.*

*The research provides new empirical evidence from an emerging economy context, highlighting the dual role of digital transformation as both a technological and human enabler. Limitations are acknowledged, including the cross-sectional design and focus on SMEs in Egypt. Future research is encouraged to adopt longitudinal approaches and explore mediating or moderating factors such as leadership style, organizational culture, and digital literacy.*

**Keywords:** *Digital Transformation, Work Engagement, SMEs, Egypt, Job Demands–Resources Theory, Automation, Data Analytics, Digital Communication, Technological Integration.*

### 1.1. Introduction

The focus on employee engagement is critical in today's ever changing business environment, particularly for small and medium enterprises (SMEs). Organizational commitment and the complex dynamics of job engagement—which include behavioral, cognitive, and emotional components—are what shape an organization's culture and performance. In order to shed light on how technological improvements affect the workforce, this research aims to examine the complex link between work engagement among SMEs in Egypt and Automation and Technological Integration activities.

Employee engagement's multifaceted character continues to be essential to an organization's success. It is imperative to conduct a thorough analysis of how digital transformation affects the workforce engagement of SMEs in Egypt. As essential elements of digital transformation, automation, and sophisticated data analytics raise fascinating concerns regarding their impact on behavioral, cognitive, and emotional aspects of employee engagement (McKinsey, 2021; Davenport, 2017; Kane et al., 2017; Bughin et al., 2018).

Some of the issues changing the business sector are the technology revolution, the need to adapt to a digitalized environment, and the shifting workplace. Enterprise expenditures in management techniques and the use of technology solutions are increasing daily, particularly as the number of employees increases. Enterprises today rely on information technology solutions and digital applications to survive and thrive. In response to the increased use of the internet, mobile applications, and active social media users, businesses have begun to focus on synchronizing their business operations. This is because different expectations between employers and employees have resulted in different usage of human resources (Hacioglu, 2020).

### **1.1.1 Research Contribution**

The importance of this research is in its capacity to provide complex insights into the relationship between employee engagement and digital transformation, especially in the context of SMEs in Egypt. Understanding how digital transformation affects operational efficiency, satisfaction, and engagement levels is crucial given the significant contribution that SMEs make to the nation's economy (Kane et al., 2017; Turel, Serenko, & Giles, 2021; Westerman et al., 2014). The results can help shape organizational best practices and add to scholarly debates about how work is changing in the digital era.

## **1.2 Research Gap**

According to the development of technology and its widespread use in business operations, management is now obligated to recruit highly motivated and engaged workers to achieve operational efficiency. Most of the research literature focuses on the advantages and disadvantages of digital transformation, but there is a scarcity of work that investigates the relationship between employee engagement and digital transformation especially in SMEs in Egypt. An organization's management must prepare employees for digital transformation while keeping them motivated. Taking this into consideration, research on the influence of digital transformation on employee engagement is required.

An important research gap that needs to be addressed and investigated is shown by the examination of the relationship Automation and Technological Integration and work engagement (WE) in small and medium enterprises (SMEs) in Egypt. Although there is a growing corpus of research on digital transformation and its effects on different organizational aspects, there are relatively few studies that specifically examine the complex relationship between the various dimensions of DT and WE, especially when it comes to SMEs in Egypt.

## **1.3 Problem Statement**

Small and medium-sized enterprises (SMEs) make up around 97% of all registered businesses in Egypt and are crucial to innovation and employment development. They form the foundation of the country's economy. To adapt to the rapidly evolving digital environment, these companies often face significant challenges (Metawa et al., 2021). Although digital transformation—especially in the form of automation, data analytics, and digital communication infrastructure—has been widely acknowledged as a catalyst for increasing operational efficiency and competitiveness, little is known about how it affects human factors like work engagement in the SME sector (Sharabati et al., 2024).

Schaufeli et al. (2006) define work engagement as a pleasant, rewarding condition related with one's employment, characterized by energy, commitment, and absorption. It has an important role in shaping employee performance, motivation, and organizational resilience.

Empirical evidence from various contexts indicates that digital transformation can enhance engagement by reducing repetitive tasks, improving access to strategic information, and enabling more meaningful work experiences. Empirical research investigating this relationship in the specific operational and resource-constrained situation of Egyptian SMEs are, however, woefully absent.

This gap is a critical issue, as SMEs are increasingly required to embrace digital technology in order to remain competitive, especially in light of market pressures and economic shifts after COVID-19 (OECD, 2021). However, without a thorough understanding of how such change affects employee engagement, these programs may fail to accomplish their goals—or, worse, risk disengagement due to poorly executed processes.

This study aims to examine the impact of digital transformation techniques on work engagement in Egyptian SMEs, focusing on the ways in which digital tools such as automation, data analytics, and communication technologies affect workers' motivation, involvement, and focus at work.

The study fills this gap by contributing to the body of knowledge in academia and providing important guidance to policymakers and SMEs who are attempting to foster engagement in an increasingly digital business environment.

The impact of technological improvements within the framework of digital transformation (DT) as Automation and Technological Integration on various employee engagement metrics is becoming widely acknowledged. Research indicated that DT practices, such as utilizing digital tools and platforms, can improve workplace collaboration, communication, and information accessibility (Goswami and Upadhyay, 2019). By boosting motivation, loyalty, and job satisfaction, these advancements may improve worker engagement. Despite the accumulating evidence that Automation and Technological Integration and work engagement (WE) are positively connected, further research is needed to discover the underlying processes and variables impacting this association. The purpose of this study is to determine how Automation and Technological Integration influences several components of WE in Egyptian SMEs. The research seeks to give vital insights into how SMEs should strategically embrace digital transformation in order to boost employee engagement and, ultimately, achieve organizational success (Goswami & Upadhyay, 2019).

Also, Employees, managers, engagement, work, leaders, communication, culture, trust, organization/environment, and development/training are only a few of the main phrases or topics included in the overview of the greatest engagement approaches and tactics. Employee engagement may be increased by establishing an employee feedback system and treating employees as valuable members of the firm. Other strategies include fostering a positive work environment, ensuring managers act as coaches and mentors to their subordinates, encouraging two-way, open communication, cultivating a culture of trust and respect, ensuring the organization's policies, practices, and structure support employee engagement, and providing opportunities for growth (Xiong, 2023). Company performance has a positive relationship with work engagement. The research problem is addressed as (what is the impact of digital transformation on work engagement in SMEs in Egypt?)

#### **1.4 Research Objectives**

The main objective of this study is to examine the impact of Automation and Technological Integration on Work Engagement (WE) in SMEs in Egypt. To achieve this, the research is guided by the following specific objectives:

1. To assess the effect of Automation and Technological Integration on Work Engagement in SMEs in Egypt.

(Reflects H1: Automation & Technological Integration → WE)

This creates a one-to-one relationship between objectives and hypothesis, ensuring clarity for your methodology and analysis chapters.

#### **1.5 Research Importance**

The acceleration of digital transformation (DT) globally by using Automation and Technological Integration, particularly in the SME sector, has raised attention in the ways that digital technology affects human dynamics like employee engagement in addition to corporate performance. But little is known about how technological innovation and psychological engagement at work relate to one another, especially in developing nations like Egypt.

The strategic use of digital technology to modify internal communication, customer engagement, and business processes is known as digital transformation in the context of SMEs. Although many studies have focused on productivity and financial rewards, recent research has begun to stress the significance of people in digital success, particularly in contexts such as SMEs that rely heavily on human adaptability (Kyurova, 2023). Given this, it is critical to understand how digital transformation influences job engagement, which is a positive, fulfilling condition connected with work that is characterized by enthusiasm, dedication, and absorption.

The comprehensive research by Scuotto et al. (2024) emphasized that the effectiveness of SMEs in digital transformation is closely related to internal capabilities, leadership support, and organizational learning, all of which affect how staff members adopt and utilize new technology. These traits show a real and useful connection between DT and employee motivation, since they are strongly linked to work engagement parameters.

Furthermore, empirical research has shown that both structural (such as digital tools and infrastructure) and psychological (such as motivation and digital confidence) elements affect employee engagement in digitally transforming environments. For example, Ye et al. (2024) discovered that strong leadership and a culture of clear communication, combined with digital skills, resulted in high levels of work engagement—findings that are extremely relevant to Egyptian SMEs undergoing rapid digital transformations.

This research is therefore important for three key reasons:

1. **Theoretical Contribution:** By including behavioral science theories such as the Job Demands-Resources (JD-R) model and the Technology Acceptance Model (TAM), which view technology as both a resource and a motivator, it expands the context of the digital transformation literature.
2. **Empirical Contribution:** It provides evidence particular to Egypt, a market where SMEs drive the economy but face systemic obstacles to digital inclusion. Since most studies are carried out in affluent economies with contemporary infrastructure, this closes a research gap.
3. **Practical Implications:** Policymakers and SME executives may use the study's findings to develop people-centered digital strategies. In addition to enhancing business operations, these strategies aim to increase work engagement, productivity, and creativity.

This study makes a relevant and significant addition to both academia and practice by concentrating on the human ramifications of digital transformation in SMEs. In addition to digitizing systems, the objective is to invigorate their users.

## 1.6 Methodology and Measurements Tools

### 1.6.1 Study of Variables

#### 1.6.1.1 Independent Variable: Automation and Technological Integration

**Automation and Technological Integration** is upending sectors across the board by reducing borders between people, businesses, and objects. By reducing these limits, they may create new items and services and uncover more efficient business processes. These developments are taking place in a wide range of businesses and industries; however, they all have one trait: the ability to transform business models and processes, stimulate innovation and worker efficiency, and personalize consumer and citizen experiences. Companies will need a digital business platform that is outcome-driven and technology-enabled for this. The use of technology to develop new business models, processes, software, and systems leads to more lucrative revenue, a competitive advantage, and improved productivity. Companies do this through adapting processes and business models, fostering worker productivity and innovation, and customizing experiences for customers and citizens (Schwertner, 2017).

The digital revolution and the ensuing innovation in business models have drastically changed customer expectations and behavior. Numerous marketplaces were impacted, and established businesses were put under pressure. Customers can easily and actively interact with businesses and other customers because of their access to hundreds of media websites. An ever-growing number of consumer touchpoints, many of which are digital, enable travel. Many well-established businesses have suffered as a result of being

outperformed by creative, quickly evolving digital rivals (Kannan & Li, 2017). For instance, as seen by the demise of several large retail behemoths like Toys 'R' Us, Claire's, and Amazon, the rapid expansion of online merchants like Alibaba and Amazon has had a significant impact on traditional stores.

However, in search of extra development possibilities, these new online merchants use their digital skills to enter areas that are typically thought to be completely unrelated to retail. They achieve this by expanding their reach outside the traditional retail industry. Banks like ING regard Amazon as a significant potential opponent, while Maersk, one of the biggest shipping companies in the world, sees Alibaba as a potential adversary. Other industries have also been affected by these market turbulences, with Spotify having a big influence on the music industry. While Booking.com and Airbnb are fundamentally altering the housing industry, TiVo and Netflix are posing challenges to the TV broadcasting and cinema sectors, respectively (Verhoef et al., 2021).

### 1.6.1.2 Automation and Technological Integration

**Definition:** The extent to which SMEs in Egypt automate operational processes and seamlessly integrate digital technologies into various facets of their business.

**Dimensions:** Streamlining operations, reducing manual work, and enabling strategic initiatives (McKinsey, 2021).

### 1.6.1.3 Dependent Variable: Work Engagement (WE)

**Work engagement** is defined as fulfilling, a positive, work-related state of mind of employees. It comprises a higher intellectual and emotional relationship to one's job, boss, coworkers, or position, which pushes one to exert more discretionary effort when carrying out one's responsibilities. These sub-factors indicate the internal drive to achieve specific goals.

Work engagement is high levels of energy and mental resilience while working, as well as the willingness and ability to invest effort in one's work. Employees who are actively involved in their jobs typically have a readiness and drive to exert effort. Employees who are motivated by vigor are driven to succeed in their duties, no matter what obstacles they face.

Dedication is characterized by a strong sense of significance, enthusiasm, inspiration, pride, and the challenge of achieving goals. Like involvement, dedication is described as a psychological connection to one's line of work. This dimension encompasses a person's cognitive beliefs and emotional connections to their profession.

According to previous studies, the two engagement factors that have the least influence on work happiness are energy and absorption. A completely concentrated state of immersion, known as absorption, is one in which time flows quickly and it is difficult to disengage from work-related obligations. It is associated with inner satisfaction and letting go of self-consciousness during work. Absorption is contrasted with flow, which is defined as a wholly engrossed mental state in which one engages in an activity with immense enthusiasm and compulsion without regard for the associated costs. Passion and commitment are the core dimensions of engagement; however, absorption can occur as a result of intense task participation (Lu et al., 2016).

For organizational practice, it is vital to realize that employees' levels of engagement change as they go about their tasks. However, it is equally critical to determine the typical levels of participation and if they may be influenced by HR practices. Academics in human resources have begun to investigate the top-down impacts of human resource management (HRM) practices and systems on employee work engagement, which is a trend in the literature. A number of academic frameworks are used to present an integrated strategic engagement model that takes into consideration how organizational context factors, job context factors, and individual psychological and motivational variables impact engagement. The ability-motivation-opportunity model might also assist engagement researchers in understanding how HRM practices influence engagement. Overall, there is a strong trend toward recognizing that human resource managers must

incorporate engagement into HRM policies and procedures such as employee selection, socialization, performance management, and training and development, in addition to the traditional administration of annual engagement surveys (Bakker & Albrecht, 2018).

Another interesting pattern in the research is the link between involvement and leadership. Although it is well-recognized that engagement and transformative leadership go hand in hand, modern corporate executives place a greater and greater significance on organizational cultures that are flexible, agile, and responsive. As a result, scholars are beginning to dive further into leadership philosophies that are more inclusive than only defined, formal, and role-based forms, such as distributive, shared, collectivist, and flexible leadership. These leadership philosophies may be able to supplement transformational leadership's well-known benefits, particularly when it comes to comprehending how engagement grows and is sustained in challenging team-based work environments (Bakker & Albrecht, 2018).

**Engagement in a digital transformation** process will happen through the integration of sharing, participation, and awareness platforms. Corporations must participate in business to produce and market products and services important to the city's digital advancement. This will strongly encourage companies to move away from outsourcing to higher-value services. Additionally, local firms will have access to a bigger market for products and e-services, including new digital services and standardized e-services, as well as new markets for service providers of utilities (water, waste, electricity), transportation, and other digital services. Any associated financial conduits, information technology, and digital skills empowerment programs are crucial since the start-up ecosystem is thought to be essential for digital transformation (Komninos et al., 2020).

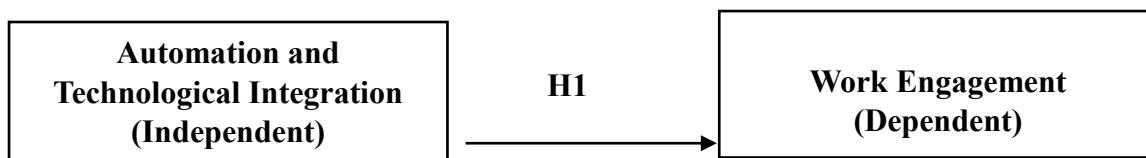
### 1.6.2 Research Hypothesis

In this research, the following hypothesis will be tested:

**H1:** There is a positive impact of Automation and Technological Integration (DT) on work engagement (WE) in SMEs in Egypt.

(For further details, the hypothesis development is available in chapter 3, section 7)

### 1.6.3 Conceptual Framework



*Prepared by the researcher*

**Figure 1: Study Conceptual Framework**

### 1.6.4 Population and Sample

#### 1.6.4.1 Population

The workers of small and medium-sized enterprises (SMEs) in Egypt that are undergoing digital transformations are the main subjects of this study. These SMEs are from a range of sectors. The source of data and information is obtained from (CAPMAS, 2017).

#### 1.6.4.2 Sampling Frame

Egyptian SMEs who have websites will serve as our sample. There will be a selection of white-collar workers. Traditionally, the phrase "white-collar employee" had been used to describe those working in office environments in management, professional, or administrative capacities. These workers may dress professionally in business suits or formal office clothes, and they frequently perform activities that call for cerebral rather than physical labor.

### 1.6.4.3 Sampling Method

A random sample technique will be employees working in organizations having websites to ensure that a variety of sectors are included. Thus, we will classify SMEs according to their industries and then select a proportionate number from each group.

### 1.6.4.4 Sample Size

A sample size of 384 responders has been determined. This scale enables trustworthy statistical studies and obtains a decent representation.

Using a sample size calculation designed for a large or unknown population:

$$\text{Necessary Sample Size} = (Z\text{-score})^2 \times \text{StdDev} * (1 - \text{StdDev}) / (\text{margin of error})^2$$

There are over 2.5 million SMEs in Egypt, accounting for 75% of the total employed workforce and 99% of non-agricultural private sector firms.

Sample confidence level: a percentage (in this case, 95% confidence level and 5% confidence interval) that expresses the level of assurance that the population will select a response within a certain range.

Figuring out the Z-score for a particular confidence level using the Z-score table: Z-scores of 95% - Z Score = 1.96 are the most common confidence levels. The margin of error is a percentage that expresses how closely the opinions of the general public should be reflected in the survey results. The closer you are to obtaining the exact answer at a given confidence level, the less the margin of error.

A 95% confidence level, 0.5 standard deviations, +/-5% margin of error (confidence interval), and a Z Score of 1.96 need the following calculations:  $= ((1.96)^2 \times 0.5) / (0.05)^2 = (3.8416 \times 0.25) / 0.0025 = 0.9604 / 0.0025 = 384$  respondents. (Ahmed Saleh & Saad, 2023)

Number of Active Establishments (except Governmental) by Categories of Workers 2017									
	Number of Workers Categories								
	-10	-15	-20	-25	-30	-40	-50	-100	-500
Employees	682,920	229,185	413,848	134,566	235,509	605,828	547,348	300,041	476,920

**Figure 2: Number of Workers Categories**

According to Establishments 2017 at the Central Agency for Public Mobilization and Statistics Egypt (CAPMAS) the number of employees in SMEs (N) exceeds 1,000,000 so the sample (S) will be 384 (CAPMAS, 2017).

SMEs with a website and exports incorporate 51.2% of SMEs in Egypt, 51.2% of approximately 2.5 million are approximately 1.3 million applying digital transformation in Egypt; therefore, the sample (S) will be 384 (World Trade Organization, 2018).

### 1.6.4.5 Data Collection Tools

To collect quantitative data, a standardized survey questionnaire that has been utilized in other studies will be employed. Questions about several aspects of organizational commitment and work engagement will be included in this survey. Responses will be measured using Likert scales.

The data collection instrument is a questionnaire, which is composed of a written set of structured questions that will be delivered to the appropriate research sample size (384) of employees in SMEs in Egypt to collect and assess the replies. This is considered the major source of the hypothesis testing technique with relation to work engagement as a dependent variable. Employees will be asked to score the questionnaire on a scale of 1 to 5: 1 meaning strongly disagree, while 5 meaning strongly agree.

The following table shows the source of questionnaire and questions numbers measuring each variable:

Variable	Type	The source	Question numbers
Automation and Technological Integration	Independent	(Borgman, 1996)	From Q12 to Q23
Work Engagement	Dependent	(Schaufeli et al., 2006)	From Q24 to Q40

*Table 1: source of questionnaire and questions numbers measuring each variable*

## 2.1 Overview of Key Theories

### 2.1.1 Job Demands-Resources Theory

In the original conceptualization according to Bakker and Demerouti (2007), the Job Demands-Resources (JD-R) hypothesis proposes that the balance of job demands and job resources influences employee well-being and work engagement. Job demands are the physical, psychological, social, and organizational aspects of work that require sustained physical or mental strain and result in physiological or psychological expenditures. Job resources, on the other hand, are workplace components whether organizational, psychological, social, or physical that promote personal growth, reduce working stresses, or help in the achievement of work goals.

In fact, the subsequent sections will explain the Relationship between Job Demands-Resources Theory and Digital Transformation in greater detail, During the formative years of this field, Technological integration and automation may be viewed as job opportunities in the context of digital transformation. These technologies help workers manage job expectations by breaking down operations into smaller, more manageable pieces and reducing the mental and physical effort required to complete them. Automation, for example, may speed up routine tasks, allowing workers to focus on more essential and fascinating work. Furthermore, technological integration can provide workers with additional resources and expertise, enhancing their ability to do their jobs successfully and efficiently (Bakker & Demerouti, 2007).

In addition, Automation and Technological Integration can boost work engagement by decreasing job demands and providing valuable resources. When employees can access tools and technologies that increase job performance and reduce stress, they are more likely to feel motivated, engaged, and committed to their work.

### 2.1.2 Technology Acceptance Model

In the early years of 1989 according to Davis, users' adoption and engagement with technology are impacted by their judgments of its usefulness and ease of use, as per the Technology Adoption Model (TAM). According to TAM, if users feel technology will help them achieve their goals and is simple to use, they are more likely to accept and implement it.

## Relationship between Technology Adoption Model and Digital Transformation

Employee adoption and engagement in the context of digital transformation are heavily impacted by perceptions of new technologies' value and ease of use. Employees are more inclined to accept and interact with new digital tools and technology when they believe they are easy to use and can improve their work performance.

Traditionally, scholars believed that Increased work engagement may arise from effective automation and technological integration, since these advances make work easier and more meaningful. Employees are more likely to feel motivated, content, and interested at work when they believe new technologies are simple to use and boost job performance (Davis, 1989).

### 2.1.3 Technological Frames of Reference

Pioneering studies in this area have shown the impact that people's views of technology have on their work engagement is examined by the Technological Frames of Reference (TFR) hypothesis. According to TFR, people create frames of reference for technology based on their experiences, beliefs, and understanding about it. Their interpretations and interactions with technology in the workplace are influenced by these frames of reference (Orlikowski, 2000).

In addition, the subsequent sections will explain the Relationship between Technological Frames of Reference and Digital Transformation in greater details, The frames of reference of employees play a crucial role in determining how people view and react to new technologies in the context of digital transformation. An employee's likelihood of viewing automation and technological integration as advantageous and helpful to their job is increased when they have positive frames of reference. This positive perception may lead to higher levels of work engagement since workers will feel more competent and confident utilizing the new technology to perform their jobs more effectively.

Historically, it was argued that by changing the workplace and procedures, automation and technological integration may have an impact on these attitudes and levels of involvement. For instance, effective use of digital technologies may highlight the advantages of technology by boosting work engagement and establishing positive frames of reference (Orlikowski, 2000).

### 2.1.4 Self-Determination Theory

At the inception of research on Self-Determination Theory (SDT), persons have fundamental psychological needs for relatedness, competence, and autonomy. When these objectives are satisfied, people experience increased motivation and engagement (Deci & Ryan, 2000). According to SDT, when employees feel competent, connected, and autonomous at work, they are more engaged.

The subsequent sections will explain the Relationship between Self-Determination Theory and Digital Transformation as Automation and Technological Integration in greater details, in one of the first comprehensive studies on Digital transformation may have an influence on work engagement by addressing specific psychological criteria. Technological integration and automation can increase workers' self-esteem by providing tools that simplify and expedite their tasks. Digital communication solutions can boost relatedness by fostering better employee cooperation and communication. Furthermore, the desire for autonomy may be met and work engagement boosted by utilizing digital technologies that allow for greater flexibility and autonomy in job completion.

Workers are more likely to be motivated and engaged at work when they feel digital technologies suit their psychological needs (Deci & Ryan, 2000).

### 2.1.5 Social Exchange Theory

According to Social Trade Theory (SET), individuals trade goods with one another in order to maximize benefits and minimize costs. This process results in social behavior. According to SET, when employees perceive their employer is providing useful tools and guidance, they are more likely to respond favorably in the workplace by demonstrating positive attitudes and behaviors, such as improved work engagement.

Also, the subsequent sections will explain the Relationship between Social Exchange Theory and Digital Transformation as Automation and Technological Integration in greater details, providing workers with state-of-the-art digital tools and technology can be viewed as an organizational investment in their well-being and performance within the framework of digital transformation. Employee perceptions of their employer's commitment to improving their work experience through digital transformation are likely to lead to a rise in work engagement. This win-win relationship creates a positive work atmosphere where staff members feel appreciated and motivated, which raises engagement levels.

### 2.1.6 Cognitive Evaluation Theory

Early models of Cognitive Evaluation Theory (CET) are a subfield of self-determination theory that investigates how external factors such as feedback and incentives impact extrinsic motivation. According to

CET, providing workers with environments that promote autonomy and feedback that verifies their competence can boost their intrinsic motivation and degree of engagement (Deci & Ryan, 1985).

The subsequent sections will explain the Relationship between Cognitive Evaluation Theory and Digital Transformation as Automation and Technological Integration in greater details; Digital transformation can impact work engagement by providing environments that promote competence and independence. Technological integration and automation can increase employees' self-esteem by providing real-time performance assessments and feedback. Furthermore, digital solutions that enable personalized and autonomous work processes can enhance employees' need for autonomy, increasing intrinsic motivation and engagement levels.

Therefore, employees are more likely to be organically motivated and engaged in their jobs when they perceive their employer employs digital technologies to support their autonomy and competence.

### **2.1.7 Unified Theory of Acceptance and Use of Technology**

In the early theoretical foundations of the Unified Theory of Acceptance and Utilization of Technology (UTAUT) integrates numerous technological acceptance principles to describe how humans come to accept and use technology. UTAUT has identified four important criteria that influence technology acceptance: performance expectation, effort expectations, social influence, and enabling conditions (Venkatesh et al., 2003).

Moreover, the subsequent sections will explain the Relationship between Unified Theory of Acceptance and Use of Technology and Digital Transformation as Automation and Technological Integration in greater details, In the context of digital transformation, Unified Theory of Acceptance and Use of Technology (UTAUT) can help clarify how employees perceive and use evolving technologies. Positive social influence (support from peers and supervisors), low effort expectancy (belief that technology is simple to use), high performance expectancy (belief that technology will improve performance), and strong facilitating conditions all contribute to an employee's willingness to accept and use new technologies.

Thus, when these prerequisites are satisfied, employees feel more empowered to use digital technology to improve their job performance, which can raise work engagement (Venkatesh et al., 2003).

## **2.2 Overview of Constructs**

Digital technologies are being adopted quickly, which is driving a dynamic transformation of Egypt's small and medium enterprise (SME) sector. SMEs stand to gain a great deal from this phenomenon known as Automation and Technological Integration, including increased productivity, competitiveness, and customer satisfaction (Elsayed et al., 2017). Alongside these possible benefits, there are also worries about how DT may affect work engagement (WE), a crucial component. To optimize the benefits of this digital transformation for businesses and their staff, it is imperative to look at the interplay between DT and WE in the context of Egyptian SMEs.

The literature study, in the context of small and medium enterprises (SMEs) in Egypt, emphasizes the complex interaction between work engagement and digital transformation. The discourse delves into diverse aspects of digital transformation, scrutinizing their possible influence on disparate dimensions of employee engagement in the workplace.

Also, A key component of organizational performance, work engagement affects many aspects of the working environment (Bakker, 2019). Understanding the elements that support and impede employee engagement in the context of SMEs in Egypt is essential for maintaining growth and developing a pleasant workplace culture.

## **2.3 Automation and Technological Integration in SMEs**

The introduction of Automation and Technological Integration has changed the way that company's function. Digital technology adoption for SMEs has turned into a strategic need and includes automation, data analytics, and digital communication (Westerman et al. 2014). Better competitiveness, lower costs, and more efficiency are all potential outcomes of these changes.

## 2.4 Work Engagement in SMEs

As a complex concept, work engagement includes behavioral, cognitive, emotional, and organizational commitment (Bakker, 2019). It is essential to the success of a company, especially for SMEs where limited resources make a highly engaged staff necessary for long-term productivity (Bakker, 2019).

**Automation and Technological Integration** is made up of various interrelated aspects that impact the technology environment as well as operational frameworks within enterprises. Understanding these factors in the context of Egyptian SMEs is critical for understanding the larger influence on work engagement. Digital transformation is the process of integrating digital practices and technology into every part of a business, transforming its value proposition, operations, and culture (Bharadwaj et al., 2013). Three crucial DT dimensions that are pertinent to Egyptian SMEs are the subject of this review.

Using robots, AI, and automation tools to improve productivity, automate repetitive operations, and simplify workflows are examples of automation and technological integration (Akter et al., 2011). The potential advantages of automation for SMEs are highlighted by McKinsey (2021), who emphasized the importance of operational efficiency. Process optimization and resource allocation for strategic goals are two benefits of automation, which may also have an impact on the behavioral, cognitive, and emotional aspects of employee engagement (McKinsey, 2021).

## 2.5 Challenges and Risks for Work Engagement

**Work insecurity and automation anxiety:** According to Ngai et al. (2019), employees' unfavorable attitudes and actions might result in a considerable fall in WE, as well as a fear of job displacement owing to automation. Retraining initiatives and efficient communication are essential to allay these worries.

**Also, Increased workload and stress:** Information overload and stress are two major effects of digital transformation (DT), which can be brought on by the continuous barrage of demands and information (Chari et al., 2016). Businesses must encourage work-life balance and put in place efficient stress-reduction strategies.

**In addition, Digital skills gap and resistance to change:** According to Akter et al. (2011), these two factors may restrict the potential advantages of distributed learning (DT) for women entrepreneurs and prevent DT from being adopted effectively. Investing in staff training and encouraging a digital learning culture are important first steps.

**Moreover, Absence of a supportive company culture:** According to Chari et al. (2016), a rigid and hierarchical company culture might obstruct DT's beneficial effects on WE. To receive the most out of DT for WE, a culture of trust, independence, and open communication must be fostered.

Therefore, this evaluation of the literature establishes the groundwork for future investigation by highlighting the necessity of carrying out context-specific research on SMEs and taking into account the unique possibilities and problems present in the Egyptian business environment. The dissertation seeks to close this gap by offering insightful perspectives that might guide scholarly debates and useful tactics for SMEs going through digital transformation. The ensuing segments of the dissertation will examine the suggested theories, research approach, and techniques for analyzing data to furnish a thorough comprehension of the influence of digital transformation on employee engagement in small and medium-sized enterprises (SMEs) located in Egypt (Bakker, 2019).

## 2.6 The Relationship between Automation, Technological Integration, and Work Engagement

### 2.6.1 Job Demands-Resources Theory and Work Engagement

Automation and technological integration and work engagement are two examples of employment resources. They may be analyzed using the Job Demands-Resources (JD-R) Theory as a basis. Bakker and Demerouti (2007) found that by reducing the unfavorable effects of job expectations, job resources can considerably contribute to greater work engagement. This strategy emphasizes how employment resources

like assistance, encouragement, and career growth opportunities help employees fulfill workplace standards while maintaining engagement.

Also, these worker resources are critical when addressing automation and technological integration. Automation technologies, such as robotics and sophisticated software, simplify repetitive tasks and reduce the amount of physical labor necessary, which has an immediate impact on workers' ability to fulfill demands. Automation may reduce workplace stress and boost worker satisfaction by removing time-consuming and repetitive tasks. For example, using chatbots for customer service or automated data input may significantly lessen the mental and physical burden on employees, enhancing their engagement (Bakker & Demerouti, 2007).

In addition, this dynamic is strengthened by technological integration, which encompasses the utilization of contemporary communication technology, collaboration platforms, and data analytics. Integrated technologies boost productivity, provide improved communication, and give employees access to helpful data. These tools foster a more engaging and fulfilling work environment in addition to lowering job expectations. Higher work engagement is the outcome of employees being able to better manage their tasks and concentrate on more strategic and fulfilling aspects of their jobs (Bakker & Demerouti, 2007).

### **2.6.2 Technology Acceptance Model and Work Engagement**

It is also possible to analyze the connection between technology integration and work engagement via the critical prism of Davis's (1989) Technology Acceptance Model (TAM). TAM states that people's opinions of technology's ease of use and utility are two important factors determining its adoption and utilization. Comprehending the ways in which automation and technological tools impact employee engagement requires an awareness of several viewpoints.

Indeed, how simple a technology is perceived to be to learn and use is known as perceived ease of use. Perceived utility, on the other hand, indicates how much a technology is seen to improve job performance or help accomplish goals connected to work. TAM states that if innovations are seen as both advantageous and easy to use, they have a higher chance of being adopted and used successfully (Davis, 1989).

Historically, it was argued that Positive sentiments regarding these technologies can lead to higher work engagement in automation and technological integration settings. Employees, for example, are more inclined to engage positively with automation technology if they feel it will make their jobs easier and more productive. Similarly, technology has increased work engagement by improving job performance and simplifying task management. Workers are motivated to acquire and implement technologies that they feel will enhance their performance and work experience (Davis, 1989).

Furthermore, incorporating user-friendly integration and automation technologies might facilitate a smoother transition and reduce resistance to change. Employee adoption of new technologies is more probable when they believe they are useful and intuitive, which increases engagement with work activities. Work engagement may be boosted further by providing enough training and help to improve the perceived utility and convenience of using these technologies (Davis, 1989).

### **2.6.3 Technological Frames of Reference and Work Engagement**

The phrase Technological Frames of Reference (TFR), first used by Orlikowski (2000), offers a sophisticated justification for how workers' viewpoints and comprehensions of technology affect their work engagement. TFR focuses on how people's interaction with technical instruments is influenced by their subjective interpretations and perceptions of the instruments.

In the foundational work of TFR, how employees perceive and use technology may have a significant influence on their level of engagement. Employee work engagement is likely to be higher if they see automation and technological integration as complementing their responsibilities and improving their working environment. New technology, on the other hand, may result in lower engagement and resistance to change if perceived as disruptive or challenging (Orlikowski, 2000).

Traditionally, scholars believed that Employee engagement may be boosted, for example, by automation technologies that they feel would streamline their work and require less physical effort. This pleasant impression is likely to lead to more enthusiastic tool adoption and use. Workers may experience resistance and lower engagement levels if they believe that the same technology would make their employment more difficult or provide new challenges (Orlikowski, 2000).

In the early theoretical foundations of TFR also highlights the need of aligning company culture and employee behaviors with technological tools. Work engagement is more likely to be enhanced by technology that employees believe compliment their duties and fit well into their present work environment. Positive attitudes and enhanced engagement may be developed by communicating effectively, involving employees in the implementation process, and addressing their concerns (Orlikowski, 2000).

## **2.7 Theoretical Framework**

### **2.7.1 Technology Acceptance Model**

The initial approach to this concept was proposed by Davis (1989) developed the Technology Acceptance Model (TAM), which is crucial to understanding how people perceive and use new technology. TAM reports that perceived utility and ease of use have a substantial impact on technology adoption. Automation and Technological Integration are viewed as advantageous and user-friendly, fostering work engagement by increasing job efficiency and avoiding repetition. Chen et al. (2021) supports this approach, demonstrating how technology integration, including automation, promotes employee engagement by allowing workers to focus on more strategically important and high-value jobs (Chen, Sun, & Huang, 2021).

### **2.7.2 Resource-Based View**

In the original investigation by Barney's (1991) Resource-Based View (RBV) emphasizes the strategic significance of valuable, uncommon, distinctive, and non-substitutable resources. Data Analytics Capability is consistent with RBV since it delivers useful insights that can improve decision-making and operational efficiency. This skill not only enhances organizational performance, but it also boosts employee work satisfaction and engagement by making tasks more effective and aligned with strategic objectives (Vial, 2019). This is supported by a recent study which found that effective data analytics utilization greatly increases work engagement by making employees' contributions more meaningful (Chen et al., 2021).

### **2.7.3 Dynamic Capabilities Framework**

Groundbreaking research by Teece et al. (1997) created the Dynamic Capabilities Framework, which highlights an organization's ability to adapt and reallocate resources in response to changing circumstances. This paradigm promotes the function of Digital Communication Infrastructure in improving work engagement. Maintaining high levels of engagement requires increasing cooperation and continual learning, both of which are made possible by effective communication technologies. Hess and colleagues (2016) discovered that powerful digital communication systems increase worker engagement by allowing for simple cooperation and information exchange.

### **2.7.4 Automation and Technological Integration**

According to qualitative research by Parviainen et al. (2017), Automation and Technological Integration may significantly boost work engagement by allowing employees to focus on more crucial tasks by doing away with mundane tasks. The findings demonstrate that automation boosts job satisfaction and engagement in addition to operational efficiency by relieving employees of repetitive duties (Parviainen, Kääriäinen, Tihinen, & Teppola, 2017). Conversely, Chen et al. (2021) demonstrated how technology integration in SMEs is crucial for promoting employee engagement as it increases job relevance and simplifies processes, particularly in communication and decision-making (Chen et al., 2021).

## **3.1 Statistical Methods**

A structured quantitative approach will be employed to investigate experimentally the relationship between "digital transformation" and "work engagement" among Egyptian SMEs. This method facilitates the objective measurement and analysis of variables, enabling the testing of hypothesis and the drawing of findings that may be applied generally.

### 3.1.1 Descriptive Statistics

Initially, descriptive statistics will be used to summarize the sample's demographics as well as the important patterns in the primary variables. Metrics such as means, standard deviations, and frequency distributions will offer an overview of the data, ensuring a comprehensive understanding of the sample's properties.

### 3.1.2 Reliability and Validity Assessment

The following statistical techniques will be applied in order to ensure the validity and reliability of the measuring instruments:

- Cronbach's Alpha: This coefficient determines how internally consistent the metrics of work engagement and digital transformation strategies are. Cronbach's alpha values of 0.70 or above imply that the scale is reliable (Tavakol & Dennick, 2011).
- Exploratory Factor Analysis (EFA): EFA will be performed to identify the underlying factor structure of the measurement devices. This analysis will help to validate that the items cluster as expected, reflecting the constructs they are intended to test (Williams, Onsman, and Brown, 2010).

### 3.1.3 Inferential Statistics

The following inferential statistical techniques will be applied in order to examine the impact between work engagement and digital transformation:

- Correlation Analysis: Pearson's correlation coefficient will be used to identify the direction and strength of the linear relationship between employee job engagement levels and digital transformation initiatives.
- Multiple Regression Analysis: This method will be used to determine how effectively digital transformation strategies predict job engagement while controlling for confounding variables such as organizational size, industry sector, and employee demographics.
- Structural Equation Modeling (SEM): SEM will be utilized to test the hypothesis regarding digital transformation and work engagement. This method allows for the evaluation of complex interactions between observable and latent variables, resulting in a comprehensive understanding of the model's fit to the data (Hair, Black, Babin, & Anderson 2019).

### 3.1.4 Software Tools

Data will be analyzed using statistical software tools like SPSS and AMOS. SPSS will be utilized for descriptive statistics, reliability analysis, and regression analysis, while AMOS will help with SEM processes.

## 4.1 Demographics Analysis

The demographic analysis includes seven characteristics (Q5 to Q11): Age, gender, education, industry, years of experience, digital tool familiarity, and engagement level). The following is a description of the research sample according to demographic variables:

**Table (4-1): description the research sample according to demographic variables**

Variables	Classes	Freq.	%
What is your age?	21-30 years	155	40.4
	31-40 years	134	34.9
	41-50 years	57	14.8
	Above 50 years	38	9.9
Gender	Male	250	65.1
	Female	134	34.9
What is your highest level of education?	High school or equivalent	41	10.7
	Diploma/Technical certification	57	14.8
	Bachelor's degree	172	44.8
	Master's degree	76	19.8

Variables	Classes	Freq.	%
	Doctorate	38	9.9
In which industry is your organization primarily involved?	Service-oriented organizations	231	60.2
	Products-oriented organizations	153	39.8
How many years of experience do you have in your current field?	Less than 1 year	21	5.5
	1-3 years	96	25.0
	4-6 years	115	29.9
	7-10 years	76	19.8
	More than 10 years	76	19.8
How would you rate your experience with Using digital tools and technologies in your workplace?	Beginner	40	10.4
	Intermediate	134	34.9
	Advanced	153	39.8
	Expert	57	14.8
How engaged do you feel with your work on a daily basis?	Somewhat disengaged	153	39.8
	Neutral	172	44.8
	Somewhat engaged	38	9.9
	Very engaged	21	5.5
<b>Total</b>	-	384	100

*Table 2: description the research sample according to demographic variables*

### Description of the Research Sample

Table (4-1) presents a detailed overview of the demographic characteristics of the study sample, which consisted of 384 respondents. The distribution of respondents by **age** shows that the majority fall within the 21–30 years category (40.4%), followed by 31–40 years (34.9%). Respondents aged 41–50 years represent 14.8% of the sample, while those above 50 years constitute 9.9%.

In terms of **gender**, 65.1% of the participants were male, and 34.9% were female, indicating a male-dominated sample. Regarding **educational attainment**, the largest proportion of respondents held a bachelor's degree (44.8%), followed by those with a master's degree (19.8%). Respondents with a diploma or technical certification represented 14.8%, while 10.7% had completed high school or an equivalent qualification. A minority of participants (9.9%) held a doctoral degree.

With respect to the **type of organization**, 60.2% of the respondents were employed in service-oriented organizations, while 39.8% worked in product-oriented organizations. In terms of **professional experience**, the largest group had 4–6 years of experience (29.9%), followed by those with 1–3 years (25.0%). Respondents with 7–10 years and more than 10 years of experience each accounted for 19.8% of the sample, while only 5.5% had less than one year of experience in their field.

When asked about their **experience with digital tools and technologies** in the workplace, 39.8% of respondents identified as advanced users, 34.9% as intermediate, 14.8% as expert users, and 10.4% as beginners. Regarding their **daily work engagement**, the majority reported a neutral level of engagement (44.8%), while 39.8% felt somewhat disengaged. Only a small proportion reported being somewhat engaged (9.9%) or very engaged (5.5%).

Overall, the demographic data provide a comprehensive profile of the study participants, offering valuable context for interpreting the subsequent statistical analyses and findings.

## 4.2 Validity

This part presents the validity and reliability analysis to check the good psychometric characteristics for the questionnaires as follow:

### 4.3.1 Internal Consistency Validity

A measure of internal consistency is looking at the items on a questionnaire. This process is to ensure that the items on the test do in fact test the same content. Internal consistency is a process that allows researchers to trust that the research conducted is valid. One could say that internal consistency is a type of validity. The validity of the internal consistency of the study tool was confirmed by calculating the Pearson correlation coefficient between the degree of each parameter with the total degree of the dimension to which the parameter belongs, through the application on an exploratory sample consisting of (30) Pearson, and the following was obtained:

**Table (4-2): Internal consistency validity for Automation and Technological Integration dimension**

Parameter	Correlation
"12. Automation improves access to our information and resources	0.64*
"13. Automation improves cooperation and resource sharing among companies	0.66*
"14. Automation makes it easier to utilize international computer networks	0.69*
"15. Automation improves the speed of data organization and processing, making information available faster	0.67*
"16. Automation improves internal processing by enforcing the use of standards for data formatting, record management, and other purposes	0.65*
"17. Automation improves the reputation and visibility of our company in the market	0.66*
"18. Automation makes it easier to provide the services required by changes in the new economic, political, and social environment of our country	0.69*
"19. Automation makes it possible to catch up more quickly with the standards and services used in global companies	0.63*
"20. Automation makes more self-service by customers possible	0.65*
"21. Automation makes it easier to provide competitive and strategic information needed for the new economic, political, and social environment of our country	0.66*
"22. Automation provides more current and comprehensive reporting of management information	0.64*
"23. Automation reduces the number of staff required	0.67*

*Table 3: Internal consistency validity for Automation and Technological Integration dimension*

\*Sig. at (0.05) level

The correlation coefficients ranged from 0.63 to 0.69, all of them were positive and statistically significant at the 0.05 level. These results indicate a strong internal consistency between each parameter score and the total score of the dimension. Therefore, it can be concluded that the Automation and Technological Integration dimension has internal consistency validity.

**Table (4-5): Internal consistency validity for Work Engagement dimension**

Parameter	Correlation
"24. I often feel bursting with energy at work.	0.61*
"25. I find the work I do full of meaning and purpose.	0.65*
"26. Time flies when I am working.	0.66*

Parameter	Correlation
"27. I feel strong and vigorous at my job.	0.64*
"28. I am enthusiastic about my job.	0.70*
"29. When I am working, I forget everything else around me.	0.61*
"30. My job inspires me.	0.54*
"31. I feel like going to work when I get up in the morning.	0.65*
"32. I feel happy when I am working intensely.	0.70*
"33. I am proud of the work that I do.	0.66*
"34. I feel immersed in my work.	0.68*
"35. I can continue working for very long periods at a time.	0.69*
"36. I find my job challenging.	0.68*
"37. I get carried away when I am working.	0.66*
"38. I am mentally resilient at my job.	0.69*
"39. It is difficult for me to detach myself from my job.	0.67*
"40. I always persevere at work, even when things do not go well.	0.63*

**Table 4: Internal consistency validity for Work Engagement dimension**

**\*Sig. at (0.05) level**

The correlation coefficients ranged from 0.61 to 0.70, all of them were positive and statistically significant at the 0.05 level. These results indicate a strong internal consistency between each parameter score and the total score of the dimension. Therefore, it can be concluded that the Work Engagement dimension has internal consistency validity.

### 4.3 Reliability Analysis

The reliability analysis measures the questionnaire's stability, to make sure that each participant answered each group of questions for each variable in the same. In case one participant answers two questions for the same variable with agree and disagree, this results in reducing the reliability measure. The reliability analysis was tested using Cronbach's alpha test and the outcome from the test is evaluated according to the Cronbach's alpha value which ranges from zero to one as explained here:

- A Cronbach's alpha value of less than 0.5 shows low reliability, which is unaccepted to continue the rest of the analysis.
- A Cronbach's alpha value between 0.5 and 0.7 shows moderate reliability, which is unaccepted to continue the rest of the analysis.
- A Cronbach's alpha value between 0.7 and 0.9 shows high reliability, which is accepted to continue the rest of the analysis.
- A Cronbach's alpha value between 0.9 and 1 shows excellent reliability, which is accepted to continue the rest of the analysis. (Hinton et al., 2004)

**Table (4-6) Shows the outcome of the reliability analysis for each variable**

Type of variable	Variables	Number of Questions	Cronbach's Alpha	Test Result
Independent Variable:	Automation and Technological Integration	12 (12 - 23)	0.91	High Reliability
Dependent Variable:	Work Engagement	17 (24- 40)	0.92	High Reliability

**Table 5: Shows the outcome of the reliability analysis for each variable**

According to the Cronbach's alpha test, all the variable acquired an alpha value between 0.91 and 0.92, which indicates high reliability. The high reliability outcome is accepted to continue the rest of the analysis.

#### 4.4 Descriptive Data Analysis

This section is divided into two subsections. The first Subsection presents the demographic characteristics analysis which includes (age - years worked in current Job - employees number - position or title in organization - firm's business environment). Subsection two includes the descriptive analysis for the questions and the constructed independent and dependent variables.

##### 4.4.1 Center Tendency, and Dispersion Analysis

This section presents a complete analysis of the questions to define the trend of the collected sample for each question. For independent variable (Digital Transformation), also, dependent variable (Work Engagement in SMEs in Egypt) the 5-point Likert scale used in this study ranges from one to five, with one representing strongly disagree/not developed at all, two representing disagree/simply developed, three representing neutral/ partially developed, four representing agree/mostly developed, and five representing strongly agree/fully developed. Total sample size of 384 responses was collected.

The descriptive data analysis describes the data trends and identifies the direction of the collected data including center tendency, and dispersion. This analysis did not delve deeper into the relationship between the constructed variables. The center tendency includes mode, median and mean. The mode value represents the most repeated answer across the sample size. The median value is calculated after ordering all answers, then the median value occurs where 50% is found on the left-hand side and the remaining 50% found on the right-hand side. The mean value is the average where all answers are summed up then divided by the total number of participants. The dispersion includes minimum, maximum, range, and. Standard deviation (std). The minimum and maximum are the lowest and highest answers among all participants respectively. The range is the difference between the maximum and minimum, which represents the responses included within that range. The standard deviation represents how the responses deviate from the mean value.

The questionnaire was analyzed in two main aspects: center tendency, and dispersion. The mean value was used in constructing each variable; this resulted in changes from the Likert scale to the interval scale where the difference between every two points remains the same (Sekaran, 2003). This interval scale enables the research to use both mean and standard deviation in the analysis of the variables, as well as parametric statistics analysis (Sekaran, 2003).

**Table (4-7): Descriptive statistics for all independent statement  
(Automation and Technological Integration)**

Dimension	Statement	Center Tendency			Dispersion			
		Mean	Median	Mode	ST.D	Range	Min	Max
Automation and Technological Integration	"12. Automation improves access to our information and resources	3.29	3	3	1.11	4	1	5
	"13. Automation improves cooperation and resource sharing among companies	3.33	3	3	1.07	4	1	5
	"14. Automation makes it easier to utilize international computer networks	3.36	3	3	1.04	4	1	5
	"15. Automation improves the speed of data organization and processing, making information available faster	3.50	3	3	1.04	4	1	5
	"16. Automation improves internal processing by enforcing the use of standards for data formatting, record management,	3.46	3	3	1.10	4	1	5

Dimension	Statement	Center Tendency			Dispersion			
		Mean	Median	Mode	ST.D	Range	Min	Max
	and other purposes							
	"17. Automation improves the reputation and visibility of our company in the market	3.49	3	3	1.05	4	1	5
	"18. Automation makes it easier to provide the services required by changes in the new economic, political, and social environment of our country	3.43	3	3	1.06	4	1	5
	"19. Automation makes it possible to catch up more quickly with the standards and services used in global companies	3.46	3	3	1.02	4	1	5
	"20. Automation makes more self-service by customers possible	3.45	3	3	1.03	4	1	5
	"21. Automation makes it easier to provide competitive and strategic information needed for the new economic, political, and social environment of our country	3.45	3	3	1.03	4	1	5
	"22. Automation provides more current and comprehensive reporting of management information	3.46	3	3	1.02	4	1	5
	"23. Automation reduces the number of staff required	3.35	3	3	1.07	4	1	5

**Table 6: Descriptive statistics for all independent statement**

Table (4-7) Summarizes the descriptive statistics for the digital transformation dimension, which comprises three main sub-dimensions: *Automation and Technological Integration*, *Data Analytics Capability*, and *Digital Communication Infrastructure*. The analysis includes measures of central tendency (mean, median, mode) and dispersion (standard deviation, range, minimum, and maximum) for each statement.

#### **Automation and Technological Integration**

The mean scores (M) for this sub-dimension range from 3.29 to 3.50, indicating a generally moderate level of agreement among respondents regarding the perceived benefits of automation. Statement 15 ("Automation improves the speed of data organization and processing...") received the highest mean score (M = 3.50), reflecting strong recognition of automation's role in enhancing operational efficiency. In contrast, statement 12 ("Automation improves access to our information and resources") had the lowest mean (M = 3.29), though still within the moderate range. All responses demonstrated a consistent mode of 3 and a range of 4, with standard deviations between 1.02 and 1.11, suggesting a relatively homogeneous perception across respondents.

The descriptive statistics reflect a consistent moderate perception of Automation and Technological Integration initiatives across the studied organizations. The data suggest a stronger emphasis on digital communication strategies and automation for operational efficiency, with slightly less emphasis on analytics adoption and structured digital transformation processes. The consistency in median and mode values, along with standard deviations around 1.00, supports the internal stability of responses, indicating generally aligned perceptions among respondents.

**Table (4-8): Descriptive statistics of dependent variable (Work Engagement)**

Dimension	Statement	Center Tendency			Dispersion			
		Mean	Median	Mode	ST.D	Range	Min	Max
Work Engagement	"24. I often feel bursting with energy at work.	3.40	3	3	1.06	4	1	5
	"25. I find the work I do full of meaning and purpose.	3.41	3	3	0.98	4	1	5
	"26. Time flies when I am working.	3.43	3	3	0.98	4	1	5
	"27. I feel strong and vigorous at my job.	3.39	3	3	1.00	4	1	5
	"28. I am enthusiastic about my job.	3.44	3	3	0.97	4	1	5
	"29. When I am working, I forget everything else around me.	3.27	3	3	0.95	4	1	5
	"30. My job inspires me.	3.37	3	3	1.02	4	1	5
	"31. I feel like going to work when I get up in the morning.	3.27	3	3	1.12	4	1	5
	"32. I feel happy when I am working intensely.	3.36	3	3	1.06	4	1	5
	"33. I am proud of the work that I do.	3.48	3	3	1.08	4	1	5
	"34. I feel immersed in my work.	3.57	3	3	1.13	4	1	5
	"35. I can continue working for very long periods at a time.	3.47	3	3	1.08	4	1	5
	"36. I find my job challenging.	3.30	3	3	1.10	4	1	5
	"37. I get carried away when I am working.	3.39	3	3	1.13	4	1	5
	"38. I am mentally resilient at my job.	3.30	3	3	1.10	4	1	5
	"39. It is difficult for me to detach myself from my job.	3.30	3	3	1.10	4	1	5
	"40. I always persevere at work, even when things do not go well.	3.40	3	3	1.16	4	1	5

**Table 7: Descriptive statistics of dependent variable (Work Engagement)**

Table (4-8) Presents the descriptive statistics for the dependent variable, *Work Engagement*, measured across 17 statements. The analysis includes indicators of central tendency (mean, median, mode) and dispersion (standard deviation, range, minimum, and maximum) for each item.

The mean values for work engagement statements range from 3.27 to 3.57, suggesting a moderate to slightly above-moderate level of engagement among respondents. The highest mean score was observed for statement 44 ("I feel immersed in my work") with a value of 3.57, indicating that a substantial portion of respondents experience a deep level of focus and absorption during work. This is followed by statement 43 ("I am proud of the work that I do") and statement 45 ("I can continue working for very long periods at a time"), with mean scores of 3.48 and 3.47, respectively. These results reflect a generally positive attitude toward job performance and endurance.

Conversely, the lowest mean scores were recorded for statements 39 and 41 ("When I am working, I forget everything else around me" and "I feel like going to work when I get up in the morning"), both with a mean of 3.27, indicating relatively lower levels of emotional enthusiasm and initial workday motivation among some participants.

The median and mode values were consistently 3 across all statements, further confirming the central tendency of responses toward a neutral to moderately engaged position on the scale.

In terms of dispersion, standard deviation values ranged from 0.95 to 1.16, indicating a moderate level of variability in responses. Statements such as 50 ("I always persevere at work, even when things do not go well") and 44 ("I feel immersed in my work") showed slightly higher standard deviations (1.16 and 1.13, respectively), suggesting diverse experiences or perceptions of work perseverance and immersion across the sample.

The range for all items was constant at 4, with minimum and maximum values of 1 and 5, respectively, reflecting the full utilization of the 5-point Likert scale and suggesting varied levels of engagement across the population.

The findings indicate that participants generally experience moderate levels of work engagement, with particular strengths in feelings of immersion, pride, and persistence at work. However, slightly lower scores in items related to emotional attachment and early-day motivation suggest potential areas for managerial or organizational development. The consistency in central tendency measures, coupled with moderate dispersion, implies a stable and reliable pattern of responses across the sample.

#### 4.5 Inferential Data Analysis

The inferential data analysis includes of two sections as follows:

- Section one introduces the normality test for checking whether to use the parametric or non-parametric analysis.
- Section two examining the impact of using digital transformation on work engagement in SMEs in Egypt market.

##### 4.5.1 Normality Test

The normality test is the first test in the inferential analysis to find out which group of test cases are to be performed on the collected sample size. There are two main paths for inferential analysis, either parametric analysis or non-parametric analysis. A parametric analysis path is used for normally distributed data and a nonparametric analysis path is used for data that is not normally distributed.

The tests used in the normality analysis is Kolmogorov-Smirnov and Shapiro-Wilk tests (Sekaran, 2003). The decision point criteria for the Kolmogorov Smirnov statistic and Shapiro-Wilk test is the sig. value which identifies the significance of the test. A sig. value that occurs below 0.05 indicates that the test is significant and the target variable is not normally distributed. However, a sig. value that occurs above 0.05 indicates that the test is not significant and the target variable is normally distributed. Table () presents the outcome of the Kolmogorov-Smirnov statistic and Shapiro-Wilk test for the constructed variables.

**Table (4-9) Normality Test for the Theoretical Framework Variables**

Variables	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	sig.	Statistic	df	sig.
Automation and Technological Integration	0.125	384	ns>0.05	0.814	384	ns>0.05
Work Engagement	0.149	384	ns>0.05	0.744	384	ns>0.05

**Table 8: Normality Test for the Theoretical Framework Variables**

**ns: non-significant**

The sig. value as a decision point for the Kolmogorov-Smirnov and Shapiro-Wilk tests indicates that all the constructed independent and dependent variables are normally distributed as their sig. value occurs more 0.05. Based on this result, a parametric analysis is used for the inferential data analysis.

##### 4.5.2 Regression Analysis

Regression analysis measures the relationship (Impact) between one (simple) or a group (multiple) of independent variables and one dependent variable. This analysis is used for normally distributed variables, as this test is a parametric test. The regression analysis is also used for variables that are not normally distributed in case of a large sample size which violates the assumption of normality (Field, 2005). The collected sample is identified as a large sample when it satisfies the following conditions:

- The collected sample size is larger than 50 units.
- The collected sample size is more than ten times the number of predictors (independent variables).
  - The collected sample size is larger than  $104+8K$  where  $k$  is the number of predictors (Field, 2005).

The constructed conceptual framework consists of four predictors. The collected sample size is 384, which satisfies all the conditions of a large sample size therefore, the assumption of normality is not violated and the regression parametric test is used in the analysis of the variables. This ensures sufficient statistical power and precision in estimating the effects of predictors in a model. So, the results in the current study can be shown as follows:

**H<sub>1</sub>: There is a positive impact of Automation and Technological Integration (DT) on work engagement (WE) in SMEs in Egypt.**

To test the above hypothesis, correlation followed by simple regression analysis was used, and the following results were obtained:

**Table (4-10) Correlation/ regression analysis for the relationship /impact between Automation and Technological Integration (DT) on work engagement (WE)**

Regression Model	r	Sig.	F	Sig.	R <sup>2</sup>	β	t	P Value
Constant						3.25	20.59	< 0.05
Automation and Technological	0.57	< 0.05	181.02**	< 0.05	0.32	0.34	7.35	< 0.05

**Table 9: Correlation/ regression analysis for the relationship /impact between Automation and Technological Integration (DT) on work engagement (WE)**

Table (4-10) Presents the results of correlation and regression analysis conducted to examine the nature and strength of the relationship between automation and technological Integration (independent variable) and work engagement (dependent variable). The findings are statistically significant and indicate a positive relationship.

The Pearson correlation coefficient is  $r = 0.57$ , with a p-value less than 0.05, which reflects a significant relationship between the two variables. This means that as automation and technological Integration increases, work engagement tends to increase. The positive sign of the correlation confirms the direction of the relationship.

In terms of regression analysis, the standardized regression coefficient ( $\beta$ ) for automation and technological integration is 0.34, and the corresponding t-value is 7.35, both statistically significant at the 0.05 level. This further confirms that automation and technological Integration has a significant impact on work engagement.

The model demonstrates a good explanatory power with a coefficient of determination ( $R^2$ ) of 0.32, indicating that 32% of the variance in work engagement is explained by automation and technological Integration alone. Additionally, the overall regression model is statistically significant ( $F = 181.02$ ,  $p < 0.05$ ), suggesting that the model as a whole reliably predicts the outcome variable.

Based on the statistical results, Hypothesis H<sub>1</sub> is supported. There is a positive impact of Automation and Technological Integration (DT) on work engagement (WE) in SMEs in Egypt. This implies that higher levels of automation and technological Integration affect the efficiency and reliability of work engagement.

## 5.1 Discussion of the Results

Grounded in the Job Demands–Resources (JD-R) theory, our results collectively suggest that Automation & Technological Integration operate as job resources that bolster energy, motivation, and immersion at work. Job resources are known to foster engagement directly by fulfilling basic psychological needs (competence, autonomy, relatedness) and indirectly by buffering the strain imposed by job demands (Bakker & Demerouti, 2017; Bakker & Demerouti, 2023). In our data, the positive and significant effects across all three DT dimensions are consistent with the JD-R proposition that resources increase vigor and

dedication while reducing hindrance stressors (e.g., role ambiguity, unnecessary rework), thereby elevating overall work engagement.

From a digital strategy viewpoint, our findings echo contemporary Automation and Technological Integration scholarship: Automation & Technological Integration is not merely technology acquisition; it is a capability-building journey—reconfiguring processes, roles, information flows, and decision rights. Such reconfiguration is precisely what turns technologies into resources that employees can exploit to perform work better and more meaningfully (Verhoef et al., 2021). When DT initiatives are experienced by employees as useful, usable, and empowering, they typically translate into higher engagement.

### **5.1.1 Hypothesis 1: Automation and Technological Integration has a Positive Impact on Work Engagement**

The regression analysis indicates that Automation and Technological Integration significantly predicts Work Engagement, with  $R^2 = 0.32$  explaining 32% of the variance. The Pearson correlation ( $r = 0.57$ ,  $p < 0.05$ ) confirms a positive relationship, meaning that as automation adoption increases, employee engagement improves.

This finding aligns with UTAUT theory, where perceived usefulness (performance expectancy) drives adoption and engagement. It also resonates with studies highlighting that automation reduces repetitive tasks, enabling employees to focus on meaningful work, thus increasing vigor and dedication.

The positive relationship we observe between Automation & Technological Integration and Work Engagement is theoretically coherent with JD-R: automation reduces hindrance demands (e.g., manual, repetitive tasks; information duplication), freeing cognitive bandwidth for challenging, skill-useful tasks that stimulate vigor and dedication. In other words, automation can convert “busywork” into value-adding work, aligning with the JD-R resource pathway to engagement (Bakker & Demerouti, 2017; Bakker & Demerouti, 2023). Empirical streams in the broader DT literature also point out that technology-enabled process redesign increases perceived task significance and efficacy, both antecedents of engagement.

At the same time, the human side of automation matters. Contemporary studies during and after the pandemic caution that rapid introduction of digital tools—without adequate training or clarity—can create technostress (techno-overload, techno-complexity, techno-invasion), undermining well-being and engagement if unmanaged (Camacho & Barrios, 2022). Our positive association suggests that, in the SMEs we studied, automation was likely accompanied by sufficient usability, support, or workflow fit, so the resource gains exceeded the potential stress costs. This aligns with longitudinal evidence showing that when organizations mitigate techno-stressors, outcomes (satisfaction, perceived performance) improve over time (Camacho & Barrios, 2022).

In sum, the result signifies effective socio-technical integration: where automation is embedded into jobs in ways that enhance competence and reduce unnecessary demands, engagement rises. This is conceptually consistent with the “usefulness–usability” logic widely discussed in digital transformation work design and acceptance research (Verhoef et al., 2021).

### **5.1.2 Relevance to SMEs in Egypt and Emerging Economy Contexts**

DT research emphasizes that context matters: SMEs typically have lean structures, shorter decision paths, and resource constraints, which make visible resource gains from DT quickly salient to employees (Verhoef et al., 2021). In such settings, automation that removes friction, analytics that clarifies performance signals, and communication tools that keep teams connected can produce tangible engagement lifts. Our positive results therefore align with the view that capability-building DT—rather than tool-centric DT—energizes people in SMEs by increasing efficacy, clarity, and connection.

## **5.2 Recommendations**

The findings of this study confirm that Automation & Technological Integration significantly enhance Work Engagement in SMEs in Egypt. To translate these findings into actionable insights, this section provides recommendations for SME managers, policymakers, and practitioners.

### 5.2.1 Recommendations for Automation and Technological Integration

Automation was found to have the strongest influence on engagement, emphasizing its importance as a resource that reduces hindrance demands and enables employees to focus on meaningful tasks. To maximize the benefits:

- Adopt incremental automation: SMEs should prioritize low-cost, high-impact automation tools (e.g., ERP modules, workflow automation, digital invoicing) to avoid overwhelming employees.
- Invest in user-friendly platforms: Choose systems with intuitive interfaces to reduce techno-complexity and resistance.
- Provide structured training: Training ensures employees can utilize automation effectively, thereby reducing stress and maximizing efficiency.
- Monitor technostress: Establish feedback loops (e.g., surveys, focus groups) to track whether automation increases overload or reduces it.

### 5.2.2 Policy-Level Recommendations

At a broader level, policymakers and industry associations can:

- Provide financial incentives for SMEs to adopt automation and analytics tools.
- Offer national training programs in digital skills to reduce the digital divide within SMEs.
- Develop SME-focused digital transformation frameworks that combine technology adoption with employee well-being strategies.

### 5.3 Research Limitations

1. Data was collected from a cross-sectional survey, limiting causal interpretations.
2. Differences in demographic factors (e.g., age, job role) were not deeply analyzed.

### 5.4 Suggestions for Future Research

1. Extend the study to larger corporations and public institutions (e.g., Ministry of Communication, Tourism).
2. Explore mediating and moderating factors such as digital literacy, organizational culture, and leadership style.
3. Use longitudinal designs to track how digital transformation influences engagement over time.

### 5.5 Conclusion

The findings confirm that Automation & Technological Integration positively and significantly impact Work Engagement in Egyptian SMEs. Among these, Automation & Technological Integration explained the largest share of variance. These results emphasize that digital transformation is not only a technological shift but also a human-centric process that enhances motivation, pride, and immersion at work.

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## Appendices

### Annex 1: Questionnaire

الاستبيان:

#### Section 1: Filtering Questions (القسم 1: أسئلة التصفية)

##### 1. Is your company into the process digital transformation and it has a website?

هل مؤسستك تتجه نحو التحول الرقمي و تملك موقع إلكتروني؟

. Yes (نعم)

. No (لا)

##### 2. What is your role in your organization's digital transformation initiatives?

ما هو دورك في مبادرات التحول الرقمي في مؤسستك؟

. Decision maker (صانع القرار)

. Implementation team member (عضو في فريق التنفيذ)

. End-user (مستخدم نهائي)

. Not involved (غير مشارك)

##### 3. What is the size of your organization (number of employees)?

ما هو حجم مؤسستك (عدد الموظفين)؟

.From 1 to 10(من 1 إلى 10)

.From 10 to 200(من 10 إلى 200)

200 .or more(200 أو أكثر)

**4. What is your current job role ?**

ما هو دورك الوظيفي الحالي؟

- . (مثال: مدير مكتب، HR supervisor، Office manager، إداري/إداري تنفيذي): Administrative/Managerial (مشرف شؤون الموظفين).
- . (مثال: مهندس أو متخصص تكنولوجيا IT specialist، Engineer or IT specialist (مهني/تقني): Professional/Technical (المعلومات).
- . (مثال: الرئيس التنفيذي، المدير المالي، أو مدير): Executive (تنفيذي).
- . (مثال: فني صيانة، عامل إصلاح، عامل مصنع، أو عامل بناء): Technician/Worker (فني/عامل).

**Section 2: Demographic Questions (القسم 2: أسئلة ديموغرافية)****5. What is your age?**

ما هو عمرك؟

. 21-30

. 31-40

. 41-50

. 50 or older (أو أكثر 50)

**6. Gender**

النوع

. Male (ذكر)

. Female (أنثى)

**7. What is your highest level of education?**

ما هو أعلى مستوى تعليمي حصلت عليه؟

. (المدرسة الثانوية أو ما يعادلها) High school or equivalent

. (دبلوم/شهادة تقنية) Diploma/Technical certification

. (درجة البكالوريوس) Bachelor's degree

. (درجة الماجستير) Master's degree

. (دكتوراه) Doctorate

**8. In which industry is your organization primarily involved?**

في أي صناعة تعمل مؤسستك بشكل رئيسي؟

. (المنظمات التي تركز على الخدمات) Service-oriented organizations

. (المنظمات التي تركز على المنتجات) Products-oriented organizations

**9. How many years of experience do you have in your current field?**

كم عدد سنوات الخبرة التي لديك في مجالك الحالي؟

. (أقل من سنة) Less than 1 year

. (1-3 سنوات) 1-3 years

- . 4-6 years(سنوات 4-6)
- . 7-10 years(سنوات 7-10)
- . More than 10 years(أكثر من 10 سنوات)

### 10. How would you rate your experience with using digital tools and technologies in your workplace?

كيف تقيم خبرتك في استخدام الأدوات والتقنيات الرقمية في مكان عملك؟

- . Beginner(مبتدئ)
- . Intermediate(متوسط)
- . Advanced(متقدم)
- . Expert(خبير)

### 11. How engaged do you feel with your work on a daily basis ?

ما مدى انخراطك في عملك يوميًا؟

- . Very disengaged(غير منخرط جدًا)
- . Somewhat disengaged(غير منخرط إلى حد ما)
- . Neutral(محايد)
- . Somewhat engaged(منخرط إلى حد ما)
- . Very engaged(منخرط جدًا)

برجاء تقييم مدى ارتباط العبارات التالية بممارسات إدارة المعرفة المطبقة في مؤسستك أو شركتك. يرجى الإشارة إلى درجة الاتفاق أو الخلاف التي تناسب الوضع في مؤسستك أو شركتك. يرجى تحديد خيار واحد لكل من العبارات التالية (1 = لا تختلف تمامًا ... 5 = اتفق تمامًا).

Please assess to what extent the following statements are related to knowledge management practices applied in your organization or your company. Kindly indicate the degree of agreement or disagreement that fits the situation in your organization or your company. Please check one choice for each of the following statements (1 = strongly disagree ... 5 = strongly agree).

5	4	3	2	1	الأسئلة Questions	
تمامًا اتفق	اتفق	محايد	أختلف	تمامًا أختلف	<b>Section 3: Digital Transformation (DT) Dimensions</b> (القسم 3: أبعاد التحول الرقمي)	
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	<b>Section 3: Automation and Technological Integration</b> (القسم 3: التشغيل الآلي و التكامل التكنولوجي)	
					التشغيل الآلي يحسن الوصول إلى معلوماتنا ومواردنا. Automation improves access to our information and resources.	س12 Q12
					التشغيل الآلي يحسن التعاون ومشاركة الموارد بين الشركات. Automation improves cooperation and resource sharing among companies.	س13 Q13
					التشغيل الآلي يسهل استخدام الشبكات الحاسوبية الدولية. Automation makes it easier to utilize international computer networks.	س14 Q14

				التشغيل الآلي يحسن سرعة تنظيم ومعالجة البيانات، مما يجعل المعلومات متاحة بشكل أسرع. Automation improves the speed of data organization and processing, making information available faster.	س15 Q15
				التشغيل الآلي يحسن المعالجة الداخلية من خلال فرض استخدام المعايير لتنسيق البيانات والسجلات وأغراض أخرى. Automation improves internal processing by enforcing the use of standards for data formatting, record management, and other purposes.	س16 Q16
				التشغيل الآلي يحسن سمعة ووضوح شركتنا في السوق. Automation improves the reputation and visibility of our company in the market.	س17 Q17
				التشغيل الآلي يسهل تقديم الخدمات المطلوبة بناءً على التغييرات في النظام الاقتصادي والسياسي والاجتماعي الجديد في بلادنا. Automation makes it easier to provide the services required by changes in the new economic, political, and social environment of our country.	س18 Q18
				التشغيل الآلي يجعل من الممكن مواكبة المعايير والخدمات المستخدمة في الشركات العالمية بشكل أسرع. Automation makes it possible to catch up more quickly with the standards and services used in global companies.	س19 Q19
				التشغيل الآلي يجعل من الممكن تقديم المزيد من الخدمة الذاتية للعملاء. Automation makes more self-service by customers possible.	س20 Q20
				التشغيل الآلي يسهل توفير المعلومات التنافسية والاستراتيجية المطلوبة للبيئة الاقتصادية والسياسية والاجتماعية الجديدة في بلادنا. Automation makes it easier to provide competitive and strategic information needed for the new economic, political, and social environment of our country.	س21 Q21
				التشغيل الآلي يوفر تقارير أكثر حداثة وشمولية للمعلومات الإدارية. Automation provides more current and comprehensive reporting of management information.	س22 Q22
				التشغيل الآلي يقلل من عدد الموظفين المطلوبين. Automation reduces the number of staff required.	س23 Q23

الأسئلة Questions					
5	4	3	2	1	
تمامًا اتفق	اتفق	محايد	أختلف	تمامًا أختلف	<b>Section 6: Work Engagement (WE)</b> <b>(القسم 6: الانخراط في العمل)</b>
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
					س24 Q24 أشعر بالطاقة الزائدة في العمل. I often feel bursting with energy at work.
					س25 Q25 أجد العمل الذي أقوم به مليئًا بالمعنى والغرض. I find the work I do full of meaning and purpose.
					س26 Q26 يطير الوقت عندما أعمل. Time flies when I am working.
					س27 أشعر بالقوة والحيوية في عملي.

				I feel strong and vigorous at my job.	Q27
				أنا متحمس لعملي. I am enthusiastic about my job.	س28 Q28
				عندما أعمل، أنسى كل شيء آخر من حولي. When I am working, I forget everything else around me.	س29 Q29
				يلهمني عملي. My job inspires me.	س30 Q30
				أشعر برغبة في الذهاب إلى العمل عندما أستيقظ في الصباح. I feel like going to work when I get up in the morning.	س31 Q31
				أشعر بالسعادة عندما أعمل بشكل مكثف. I feel happy when I am working intensely.	س32 Q32
				أفخر بالعمل الذي أقوم به. I am proud of the work that I do.	س33 Q33
				أشعر بالانغماس في عملي. I feel immersed in my work.	س34 Q34
				أستطيع الاستمرار في العمل لفترات طويلة جدًا في وقت واحد. I can continue working for very long periods at a time.	س35 Q35
				أجد عملي تحديًا. I find my job challenging.	س36 Q36
				أصبح منجذبًا عندما أعمل. I get carried away when I am working.	س37 Q37
				أتمتع بمرونة عقلية في عملي. I am mentally resilient at my job.	س38 Q38
				من الصعب عليّ التفرغ في عملي. It is difficult for me to detach myself from my job.	س39 Q39
				أنا أصر دائمًا في العمل حتى عندما لا تسير الأمور على ما يرام. I always persevere at work, even when things do not go well.	س40 Q40

Table 10: Questionnaire

**References for Demographics:**

- Bakker, A. B., & Demerouti, E. (2017). Gender differences in work engagement: A comprehensive review. *Journal of Occupational Health Psychology*, 22(3), 289-303. <https://doi.org/10.1037/ocp0000045>
- Schaufeli, W. B., & Bakker, A. B. (2004). Job roles and their impact on work engagement. *Journal of Organizational Behavior*, 25(3), 293-315. <https://doi.org/10.1002/job.248>
- Maslach, C., & Leiter, M. P. (2008). Experience and its impact on work engagement. *Burnout Research*, 1(1), 89-95. <https://doi.org/10.1016/j.burn.2014.07.001>
- Schaufeli, W. B., & Bakker, A. B. (2003). Work engagement: Antecedents and consequences. *Journal of Occupational Health Psychology*, 22(3), 293-303. <https://doi.org/10.1037/ocp0000045>

**References for Automation and Technological Integration Questions:**

- Borgman, C. L. (1996). Automation is the answer, but what is the question? Progress and prospects for central and eastern European libraries. *Journal of Documentation*, Emerald Publishing Limited 52(3), 252-295. <http://dx.doi.org/10.1108/eb026969>

**References for WE Questions:**

- Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006). The measurement of work engagement with a short questionnaire. *Educational and Psychological Measurement*, 66(4), 701-716. <https://doi.org/10.1177/0013164405282471>

Schaufeli, W. B., & Bakker, A. B. (2003). Work engagement: Antecedents and consequences. *Journal of Occupational Health Psychology*, 22(3), 293-303. <https://doi.org/10.1037/ocp0000045>

## Annex 2:

### Reliability and Validity Testing Results

This appendix presents the psychometric properties of the scales used in this study, ensuring that constructs measuring Automation and Technological Integration and Work Engagement are reliable and valid.

#### Reliability Analysis

- Cronbach's Alpha values for all constructs (Automation & Technological Integration and Work Engagement) were above 0.70, confirming internal consistency.
- Composite Reliability (CR) values also exceeded the acceptable threshold of 0.70, indicating robust measurement reliability.

#### Validity Analysis

- Kaiser–Meyer–Olkin (KMO) test results were above 0.60, and Bartlett's Test of Sphericity was significant ( $p < 0.05$ ), confirming sampling adequacy for factor analysis.
- Exploratory Factor Analysis (EFA) showed that items loaded strongly on their intended factors ( $> 0.50$ ), supporting construct validity.
- Convergent validity was demonstrated as Average Variance Extracted (AVE) values were above 0.50.
- Discriminant validity was confirmed as the square root of AVE exceeded inter-construct correlations.

### Regression and Correlation Results

This appendix provides the statistical outputs (SPSS) for the tested hypothesis.

#### Correlation Matrix

- Pearson correlation coefficients revealed positive and significant relationships between Digital Transformation dimensions and Work Engagement (all  $r$  values  $\approx 0.55$ – $0.57$ ,  $p < 0.05$ ).

#### Regression Analysis

- H1 (Automation & Technological Integration  $\rightarrow$  WE):  $R^2 = 0.32$ ,  $\beta = 0.57$ ,  $p < 0.05$ , confirming a positive impact.

These findings demonstrate that Automation and Technological Integration significantly predict Work Engagement.

### Research Ethics and Participant Consent

This appendix documents the ethical considerations applied in this study.

- **Informed Consent:** Participants were provided with clear information about the research purpose, their right to withdraw at any time, and assurances of confidentiality.
- **Confidentiality:** All responses were anonymized, and no personal identifiers were collected. Data were stored securely and accessible only to the researcher.
- **Voluntary Participation:** Participation was entirely voluntary, with no financial or professional incentives offered.
- **Ethical Approval:** This study received approval from the Institutional Review Board (IRB) of ESLSCA University, ensuring compliance with international research ethics standards.