
**Retaining Employees with Adoption of Industry 4.0 Technologies in the
Automotive Sector– Mediation of Training 4.0 & Employee Competency**

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Abstract

This research aims to elaborate on the impact of Industry 4.0 adoption on Employee Retention in light of the Unified Theory of Acceptance and Use of Technology (UTAUT) theory. The data for this causal-explanatory study was collected from a sample of 275 respondents. The Partial Least Square Structural Equation Modeling statistical technique was used to analyze in-sample and out-of-sample predictive power. The findings indicate that Industry 4.0 adoptions affect Employee Retention. The mediation analysis reveals that Training 4.0 and Employee Competency mediate the relationship between i4.0 adoption and Employee Retention. This study indicates that training related to industry 4.0 and employee competencies having a skill set related to technological change affect employee retention. The role of training 4.0 and Employees' competencies as mediators indicate that retention is influenced when employees are provided similar training for I4.0. When organizations focus on developing employee competencies, they tend to remain in the company for a long time. This study provided evidence of an empirical relationship between Industry 4.0, Employee Retention, Employee Competencies, Industry 4.0 readiness, Management support and Training i4.0.

Keywords: Industry4.0, Employee Retention, Automotive industry, Industry 4.0 adoption, Management support, Training 4.0

Introduction

Employee retention is a longstanding construct of the study. The primitive work of human resource and management researchers claims the phenomenon to be the most thought-provoking phenomenon for managers. Existing evidence in literature indicates that employee retention is contingent upon incentive, remuneration, and psychological factors (Khalid and Nawab, 2018; Al Kurdi, Alshurideh and Al afaishat, 2020; Ikram *et al.*, 2021). Many scholars use employee turnover or retention simultaneously with the same meaning. The birth of this phenomenon emerged in 1917, defined by Hom *et al.* (2017), after which scores of persistent scholars worked on different research gaps.

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Technological advancements have also shifted the dimensions of study for employee retention strategies. The recent work has moved to new terms like human resource management practices, talent management tools, and technological adoption (Gill *et al.*, 2010; Singh, 2019; Amushila and Bussin, 2021). However, the factors like motivation, empowerment, and satisfaction have been investigated more intensely in recent studies. This study seeks to make a valuable contribution to the understanding of the various factors and qualities that influence the ability of organizations to retain their employees. This study examines the influence of industry 4.0 adoption as an independent variable on many factors such as standard of life, income, flexibility, remote work, employee participation, and training. Previously, I4ie has identified human capital as the organization's most precious asset, from which they can gain competitive advantages through valorization (Fulmer and Ployhart, 2014; Flores, Xu and Lu, 2020). Training refers to teaching or developing a particular skill set, knowledge, or behavior related to a specific task, in the past E. Cohen (2017) and Costen, W.M. and Salazar (2011) defined it as providing employees with the required skills and knowledge to perform tasks correctly. Another variable competency is used in many studies. It is defined as the ability/capability to use skillset, expertise, and abilities to perform the required tasks and operations successfully or whether someone will do well in a particular role or circumstance. (Bhardwaj and Punia, 2013).

Similarly, this study assesses management support – a longstanding construct – which may provide new dimensions for management support. Management support is the support top management offers to create a supportive environment, helping boost performance and enchanting employee trust (Ernst, 2002). Considering the new trends in the research world, the introduction of i4.0 readiness as a construct is used to explain the extent to which organizations can take advantage or disadvantage of new IT technologies in their daily processes (Haug, Graungaard Pedersen and Stentoft Arlbjörn, 2011; Dyerson, Spinelli and Harindranath, 2016; Hopkins, 2021; Patil *et al.*, 2023). The current study aims to assess how these variables are linked and affect employee retention.

Problem Statement

The technological adoption techniques and their impact have recently been a hot topic. Many studies discussing technological adoption make different theories the basis of their work. The Theory of Reasoned Action (TRA) and the Technological Acceptance Model (TAM) are the most common frameworks for technology adoption. This study aims to use the unified theory of acceptance and use of technology (UTAUT) as theoretical underpinnings (Venkatesh *et al.*, 2003). UTAUT has been used to conceptualise technology adoption in other contexts (Al-Saedi *et al.*, 2020; Bramo, Desta and Syedda, 2022; Shakeri *et al.*, 2022) but not to explain employee retention. Therefore, this study assesses how employee retention and i4.0 adoption through the lens of UTAUT. Furthermore, the objective of this study is to establish a clear correlation between the adoption of Industry 4.0 technologies and the ability of a company to retain its employees. Previously, the effect of technology adoption on employability, employee empowerment, and training has been established but not directly on employee retention (Sharma *et al.*, 2022).

The moderators and mediators used in this study are considered to yield new indirect and moderating relationships of employee retention. Although training 4.0 and employee competencies have been established as mediators in other contexts (Naim and Lenka, 2018; Herawati *et al.*, 2021), This study investigates the role of training and staff competencies as mediators between i4.0 adoption and employee retention. The moderator i4.0 readiness is also used in a different context in literature (Samaranayake, Ramanathan and Laosirihongthong, 2018). Samaranayake *et al.* (2018) suggested getting deeper insights by empirically testing readiness in other contexts.

Therefore, the current work intends to examine whether i4.0 readiness moderates the relationship between i4.0 adoption and employee retention.

The employee retention strategies have attracted managers' attention as employees are now considered "assets" (Singh, 2019). Therefore, managers are more interested in training and developing human capital to increase employee retention. Thus, this study can guide managers on how i4.0 adoption facilitates employee retention while considering other study factors. In addition, this study aims to introduce a novel self-confidence factor, "employee competency," which can facilitate the implementation and adoption of new market trends for organizational development. Incorporating this factor can enhance employees' confidence levels and empower them to navigate the evolving market landscape effectively (Walter and Stella, 2018).

Though industry 4.0 is not a new concept worldwide, Pakistan is moving towards this phenomenon as a developing country. Previous studies have shown how industry 4.0 affects employee retention through qualitative assessment. Moreover, the results were obtained from a specific country or industry, making it challenging to extrapolate them to other countries or contexts. Therefore, this study aims to empirically test the direct relationship between industry 4.0 technology adoption and employee retention (Eickemeyer *et al.*, 2021). Previous research has been conducted in other regions, while this study examines the effect of adopting i4.0 technologies on employee retention in Pakistan. Previous studies show the impact of i4.0 on banking (Mehdiabadi *et al.*, 2020; Gupta, 2021) and nursing industries (Cui *et al.*, 2018; Diño and Ong, 2019) in different dimensions. The current research deals with the automotive sector of Pakistan.

Therefore, this study aims to answer the following research questions:

1. What is the effect of industry 4.0 on employee retention in an organisation?
2. Do training 4.0 and employee competency intervene in the relationship between i4.0 adoption and employee retention?
3. Do management support and employee readiness affect the relationships?

This study will be significant in terms of its findings. In a study conducted by Eickemeyer *et al.* (2021), the authors explained how relevant training and management support while implementing a new technology aids in employee retention. Previously, technological adoption has been found to affect employability and employee empowerment significantly but not employee retention (Sharma *et al.*, 2022). The critical significance of our study is that we are conducting quantitative research on this topic in the Automotive sector of Karachi, Pakistan, to study how Industry 4.0 affects Employee retention. Moreover, in a recent study, Sony *et al.* (2021) called for further research on industry 4.0 in the automotive industry context. Therefore, the findings of this study can be useful for the regions at the early adoption stage.

Literature Review

Employee Retention

Employees are considered the most vulnerable asset for organizations that actively participate in the profitability and success of an organisation (Singh, 2019). Retaining a talented human pool contributes to profitability and reduces the expenses of recruitment, training, and development for new employees (Sandhya, 2011; Khalid and Nawab, 2018). Many scholars have given numerous definitions for this construct. Employee retention refers to the strategies implemented by organizations to retain their skilled workforce for a longer duration (Sandhya, 2011; Khalid and Nawab, 2018; Singh, 2019; Al Kurdi, Alshurideh and Al afaishat, 2020). Employee retention has emerged as a hot issue for every sector for decades. Now organizations have started looking into the matter and developing strategies to retain their talented employees (Khalid and Nawab, 2018; Al Kurdi, Alshurideh and Al afaishat, 2020). Researchers have examined various elements that

can influence employees' inclination to remain with the same business (Sandhya, 2011) has considered motivation as one of the driving agents for employee retention. Others have taken different psychological and social drivers such as job security, job satisfaction, affiliation, esteem and self-actualization, compensation, corporate reputation, and internal branding (Khalid and Nawab, 2018; Al Kurdi, Alshurideh & Al afaishat, 2020; Ikram *et al.*, 2021). However, for recent trends, a literature review by Singh (2019) has highlighted new drivers of employee retention. His work also supports how adopting technology and digitalization can drive employee retention for organizations, which is mentioned as the “gig economy.” The literature review by Singh (2019) is a building block of our conceptual model, which aims to test how adopting new technological skills can enhance employee retention.

Theoretical Underpinnings

Technology and science have emerged as revolutionary forces in human civilization, catalyzed by industrialization, social relationships, and the development of societies. Scholars have long studied this dynamic evolution, dating back to the third industrial revolution decades ago. Scholars usually assess technology adoption through the lens of the theory of reasoned action (TRA), Technology acceptance model (TAM), and Motivation model (MM). However, based on the theories above, Venkatesh *et al.* (2003) proposed the “Unified theory of acceptance and use of technology (UTAUT)”, in which he suggested the adoption of technology is based on behavioral intention. It aims to explain the individual's intention to use the relevant technologies and the continuous commitment to the usage. The UTAUT model consists of four primary constructs: performance expectancy (individual's perception of improving the specific job by adopting technology), effort expectancy (the easiness of using technology), social influence (individual's perception of his adoption importance in other's perspective), and working conditions (enablers at an organisation which makes technological adoption easy) (Venkatesh *et al.*, 2003). These four primary constructs drive the intention of use, leading to the usage behavior. Moreover, age, gender, and experience may moderate the impact.

The UTAUT model has been in debate for empirical testing in recent times. Many scholars have tested this theory in different contexts (Al-Saedi *et al.*, 2020; Abbad, 2021; Bramo, Desta and Syedda, 2022; Shakeri *et al.*, 2022). The study's conceptual model is derived from the UTAUT paradigm, and it aims to examine the influence of technology adoption (specifically, Industry 4.0 adoption) on an individual's commitment to continuous usage in terms of employee retention in the automotive sector of Pakistan. The construct of industry 4.0 adoption is self-explanatory for the performance expectancy construct of the UTAUT model. By trickle-down effect, this construct measures the performance improvisation employees' perspective (quality and ease of job). Industry 4.0 readiness in the present study proxies the effort expectance of the UTAUT model, which measures how the organisation and its employees find the adoption easy due to available resources and conditions. Employee competency measures the employee's self-confidence to adopt the technology (social influence). The constructs of Management support and training 4.0 in the conceptual model refer to the working conditions of the organisation, which lead to the intention to adopt and commit to continuous use (retention).

Employee Retention and Industry 4.0 Adoption

The world has recently witnessed the peak of technological advancements, and digitalization has converged everything just a tap away. Similarly, the newest term revolving in the market is Industry 4.0. Recently, scholars have worked on different dimensions of Industry 4.0. Many organizations undertake the integrated version of Industry 4.0 is the latest tech-based skills and measures to sustain the productivity, growth, and efficiency of both soft and hard assets (Agostini

and Nosella, 2020; Tortorella *et al.*, 2020; Sharma *et al.*, 2022). The 4th revolution of the industry is the new set of technologies consisting of cloud computing, big data analytics, robotics, artificial intelligence, augmented reality, and internet of things. (Sharma *et al.*, 2022). Indeed, this is a very new concept, and the latest generation of organizations is planning to adopt these technologies. However, this adoption not only precisely improves productivity but also impacts the internal stakeholders of organizations. For example, the threat of unemployment and job insecurity cultivates among employees (Eickemeyer *et al.*, 2021; Ejsmont, 2021).

On the other hand, the training and learning required skills for adoption can reduce the threats mentioned above (Ejsmont, 2021). Furthermore, qualitative and quantitative research suggests a direct positive relationship between Industry 4.0 adoption and employee retention (Ejsmont, 2021; Sharma *et al.*, 2022). Moreover, while discussing the adoption of Industry 4.0 and employability skills, Sharma *et al.* (2022) concluded that adopting these technology sets can enhance employee retention and increase employee participation and satisfaction. Therefore, we propose a positive impact of Industry 4.0 on employee retention.

H₁: Industry 4.0 adoption positively impacts Employee retention

Mediating Role of Training 4.0

Training refers to teaching or developing a particular skill set, knowledge, or behaviour related to a specific task. It gives employees the skills and expertise to perform tasks correctly (E. Cohen, 2017; Costen, WM and Salazar, 2011). Training is an organised activity to enhance an employee's performance by assisting them in attaining a required level of knowledge or proficiency (Guan and Frenkel, 2019; Singh *et al.*, 2019).

With any new technology implemented in an organisation comes a need to train the employees. In this age of digitalization, where new technologies are being introduced rapidly, employees' skillsets and knowledge have become more critical for management and other stakeholders (Presbitero, Roxas and Chadee, 2016). In addition, training and development enhance the employees' commitment and dedication to the organisation, reducing turnover and increasing retention (Bibi, Ahmad and Abdul H. A. Majid, 2018; Bibi, Ahmad and Abdul Halim Abdul Majid, 2018; Naim and Lenka, 2018). George (2015) conducted a study to examine the retention of experienced employees in organizations and concluded that training and development are among the factors that firmly relate to employee retention. Al-sharafi (2018) concluded in their study that training not only improves employee retention but also reduces employees' stress and mistakes and increases their confidence, ultimately leading to higher satisfaction. In contrast, Haines *et al.* (2010) argued that training does not increase employee retention; it only makes them more attractive to other employers. From the previous discussions, it is still unclear whether training positively or negatively mediates any new technology adoption and employee retention. Further research is needed to comprehend better the mediating role of training between Industry 4.0 adoption and employee retention. This study proposes that training mediates the Industry 4.0 adoption and employee retention through a two-tailed testing.

H₂: The relationship between Industry 4.0 adoption and employee retention is positively mediated by Trainings 4.0.

H_{2a}: Industry 4.0 positively affects Trainings 4.0

H_{2b}: Trainings 4.0 positively influences employee retention.

Mediating Role of Employee Competencies

Competency is the ability/capability to use skillset, knowledge, and abilities to perform the required tasks and operations successfully or whether someone will do well in a particular role or circumstance (Potnuru and Sahoo, 2016; Potnuru, Sahoo and Sharma, 2019). Bhardwaj (2013)

acceded to this definition: it is a mix of knowledge, skills, and attitude required for effective performance.

Employee competencies are crucial in implementing new technology and innovation in an organisation. According to TAM, any successful innovation/adoption depends on two factors; perceived usefulness and perceived ease of use by the users (Davis and Davis, 1989). When any innovation is implemented, it is the competency of the employees that make it successful. Employee Competencies are considered an essential part of the workforce as it makes people creative and gives a sense of ownership of their jobs (Hernandez-de-Menendez *et al.*, 2020). Implementing industry 4.0 in the automotive sector requires employees to have specific competencies to excel at their jobs. Industry 4.0 continuously evolves, and employees must acquire new skills (Hernandez-de-Menendez *et al.*, 2020). In past research, employee competency is an established mediator between training, employee performance, and organizational effectiveness (Mahmood *et al.*, 2018; Otoo, 2019).

Moreover, the existing literature shows that increasing employee competency through knowledge sharing results in their intention to stay (Naim and Lenka, 2018). Therefore, this study enhances the current understanding by investigating how competencies act as intermediaries in the connection between Industry 4.0 and worker retention. Thus, we propose the following hypothesis:

H3: The relationship between Industry 4.0 adoption and Employee Retention is positively mediated by Employee competency.

H3a: Industry 4.0 adoption positively influences Employee Competency.

H3b: Employee Competency positively influences Employee Retention.

Industry 4.0 readiness as moderator and Industry 4.0 Adoption

i4.0 readiness pertains to the extent to which organizations can benefit or suffer from the use of new IT technologies in their day-to-day operations. (Haug, Graungaard Pedersen and Stentoft Arlbjørn, 2011; Dyerson, Spinelli and Harindranath, 2016; Hopkins, 2021; Patil *et al.*, 2023). The dimensions of industry 4.0 readiness may encompass several critical factors, such as the imperative to transform current processes, a willingness to embrace technological risks, a profound understanding of emerging technologies, a workforce equipped with the necessary expertise and enthusiasm to navigate and utilize advanced tools, and a significant level of top management support in terms of both financial investment and a positive outlook towards innovation (Haug *et al.*, 2011). Previous research by Tortorella *et al.* (2019) has examined the role of Industry 4.0 as a moderator in the relationship between lean production (LP) and operational performance improvement in Brazil, a context of a developing economy. While industry 4.0 adoption is considered as an independent variable in this study, a company's preparation for adoption can also have a substantial impact. Therefore, this study investigates the impact of the specified construct to evaluate additional aspects of industry 4.0 readiness (Samaranayake *et al.*, 2018). The literature is scant to show the direct impact of technological adoption and employee retention. Therefore, the current study hypothesizes the moderating effect of industry 4.0 readiness between the independent and dependent variables of the study.

H4: i4.0 Readiness positively moderates the relationship between i4.0 adoption and Employee Retention.

Management Support as a moderator and Industry 4.0 Adoption

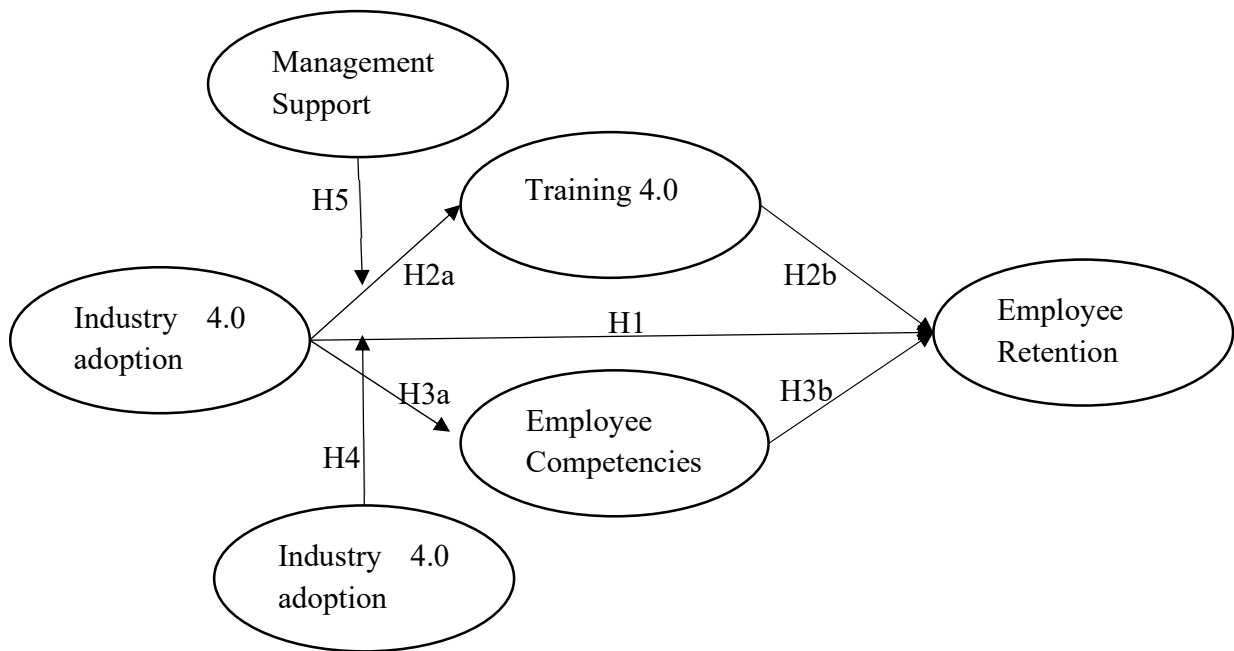
Management support refers to providing desired support in all operations and giving business directions (Hsu *et al.*, 2019; Barham *et al.*, 2020). Management support refers to the support provided by top management to create a supportive environment, helping in performance boosting

and enhancing trust amount employees. (Prieto-Pastor and Martin-Perez, 2015; Barham *et al.*, 2020). Management support is generally linked to the capability of management to figure out disparate employees' needs, arrange training that aligns with employees' jobs, manage the social relationship to engage employees enrolling in training programs, make someone feel valued, cared for and continue positive effect on others (Issah, 2018; Mohamad, Ismail and Nor, 2020) Management support can increase or decrease the adoption of new technology within an organisation (Franceli and Zilber Turri, 2021). Based on the previous work, the current study is supposed to test the moderating effect of management support between i4.0 adoption and training, positively impacting employee retention. Furthermore, numerous studies have used the construct as a moderator between different variables (Prieto-Pastor and Martin-Perez, 2015; Franceli and Zilber Turri, 2021). Therefore, the developed hypothesis for the current study can be:

H5: Management support positively moderates the relationship between i4.0 adoption and Training 4.0.

The Conceptual Model

Figure 1 Conceptual Framework



Methodology

This study is causal-explanatory, quantitative research based on the post-positivism philosophy (Saunders *et al.*, 2019). It follows a deductive research approach because data collected through a questionnaire is used to test the literature-backed hypotheses (Soiferman, L.K., 2010).

Sample and Sampling procedure

Our population includes people working in the automotive sector of Pakistan because Industry 4.0 is one of the latest trends in Pakistan. Most automotive companies have been the early adopters of this concept, which will help us study its effect on employee retention. The sample size is a primary decision of any research; an adequate sample delivers the expected results more precisely (Tabachnick, B. G., & Fidell, 2016). G*Power, a statistical power calculator, suggests a minimum

sample size of 77 based on the number of predictors and effect size. However, [Kline \(2016\)](#) recommends the exact sample size be ten times the number of items in the study. Therefore, the exact sample size for this study is 290, as a total of 29 items are deployed for data collection. The sample consists of 258 responses from the Industry 4.0 aware, middle, and upper-level management members of different automotive organisations in Pakistan using a purposive sampling technique ([Etikan, 2016](#)).

Data collection tools and analysis

Previously validated scales were adapted for this study, including Industry 4.0 adoption ([Tortorella et al., 2020](#)), Training 4.0 ([Potnuru and Sahoo, 2016](#)), Employees' Competencies ([Potnuru, Sahoo and Sharma, 2019](#)), Management Support ([Prieto-Pastor and Martin-Perez, 2015](#)), i4.0 Readiness ([Stentoft et al., 2021](#)), and Employee Retention ([Mueller, Wallace and Price, 1992](#)). Partial Least Square Structural Equation Modeling (PLS-SEM) statistical technique using SmartPLS 4.0 was deployed to analyze the data. This technique is usually employed when data is skewed or kurtotic i.e., not normally distributed ([Hair, Sarstedt and Ringle, 2019](#)). Data on attitudes, beliefs, and perceptions are rarely normally distributed in real life, and almost every data set is non-normal ([Hair et al., 2018](#)).

Results

Data were screened to remove the missing value and outliers as a first step of the analysis. Next, common method bias (CMB) was assessed using a full collinearity test. The variance inflation factor of all the variables regressed on a random variable was less than 3.3, indicating the absence of CMB. Table 1 presents an overview of the characteristics of the sample. The findings reveal that the majority of participants were male, accounting for 77.7% of the sample. The age distribution of the sample was consistent with that of Pakistan, with most participants falling between the ages of 21 and 30. This is in line with the fact that nearly 30% of Pakistan's population falls within this age range ([Kundi, 2018](#)). Furthermore, most participants had less than ten years of work experience, which is typical for managerial positions. As the sample consisted of individuals in managerial positions, the majority had higher levels of education. Regarding the hierarchy, most participants held lower-level managerial positions, with only ten per cent reporting that they were departmental heads. Additionally, the participants held various job titles from various functional business areas.

Table 1 Sample Profile

Variable	Category	Frequency	Percentage
Gender	Male	199	77.7
	Female	57	22.3
Age	21-30	130	50.6
	31-40	93	36.2
	41-50	32	12.4
	51-60	2	0.8
	60 or above	0	0
Working Experience	1-5 years	121	47.3
	6-10 years	99	38.7
	11-15 years	30	11.7
	16-20 years	6	2.3
	More than 20 years	0	0
Designation	Assistant Manager	83	32.4
	Supervisor/Team lead	35	13.7
	Senior Manager	68	26.6
	Department Head	27	10.5
	Other	43	16.8
Education Level	Matriculation	0	0
	Inter	2	0.8
	DAE	2	0.4
	Bachelors	100	39.2
	Masters	152	59.6
Department	Production	75	29.2
	IT	68	26.5
	Supply Chain	59	23
	HR	33	12.8
	Other	21	8.5

Subsequently, the Mardia's Test was used for checking multivariate skewness and kurtosis. The p-values for skewness and kurtosis must be below 0.05 to conclude that the data is not normally distributed and lacks multivariate normality. The results shown in

Table 2 Mardia's Test of Multivariate Normality suggest that the sample data for this research is not normally distributed, as the p-values for skewness and kurtosis are less than 0.05 (Cohen, 1988). Hence, the sample data is skewed and kurtotik, warranting the use of SMART PLS4 for our statistical analysis.

Table 2 Mardia's Test of Multivariate Normality

	Beta Coefficient	Z-value	P-value
Skewness	393.961	16940.321	0.000
Kurtosis	1667.255	33.525	0.000

A measurement model assessment was made as a first step of the PLS-SEM method. Indicator reliability is the representation of the construct through its items. Table 3 indicates that the constructs are well-represented by its items, as all the values of outer loading were greater than the threshold value of 0.7. Composite reliability, the internal consistency of the items of a construct, is above the threshold value of is 0.70. The average Variance Extracted (AVE), representing the convergent validity of all the constructs, is higher than the threshold value of 0.5 (Fornell & Larcker, 1981).

Table 3 Outer Loading, Composite Reliability, and Average Variance Extracted

Construct	Item Code	Indicator Reliability / Outer Loadings	Composite Reliability	AVE
Employee Competencies	EC1	0.829	0.935	0.705
	EC2	0.861		
	EC3	0.827		
	EC4	0.837		
	EC5	0.846		
	EC6	0.837		
Employee Retention	ER1	0.925	0.968	0.882
	ER2	0.945		
	ER3	0.943		
	ER4	0.943		
Management Support	MS1	0.899	0.957	0.848
	MS2	0.932		
	MS3	0.929		
	MS4	0.924		
Training 4.0	T4.0-1	0.925	0.965	0.873

	T4.0-2	0.943		
	T4.0-3	0.933		
	T4.0-4	0.935		
	i4.0-A1	0.817		
Industry 4.0 Adoption	i4.0-A2	0.895	0.917	0.735
	i4.0-A3	0.885		
	i4.0-A4	0.829		
	i4.0-R1	0.736		
	i4.0-R2	0.839		
	i4.0-R3	0.879		
Industry 4.0 Readiness	i4.0-R4	0.899	0.953	0.746
	i4.0-R5	0.921		
	i4.0-R6	0.889		
	i4.0-R7	0.867		

Discriminant validity assesses the extent to which constructs are distinct or differentiated. The discriminant validity is checked by the Heterotrait-Monotrait (HTMT) ratio. The cut-off value for the HTMT ratio is 0.85 (Claes Fornell and David F. Larcker, 1981). Although the pairwise HTMT ratio of Management Support/ Employee Retention constructs and i4.0 readiness/ management support is higher than 0.85, the class interval of the HTMT ratio does not contain 1. Therefore, the findings indicate that the constructs have discriminant validity (Table 4).

Table 4 Discriminant Validity via HTMT Ratios

	EC	ER	MS	T4.0	i4.0-A
EC					
ER	0.423				
MS	0.544	0.923			
T4.0	0.612	0.867	0.718		
i4.0-A	0.464	0.803	0.753	0.777	
i4.0-R	0.561	0.94	0.948	0.874	0.834

Note: i4.0-A = i4.0 Adoption, T4.0 = Trainings 4.0, EC = Employee Competency, MS Management Support, i4.0-R = i4.0 Readiness, ER = Employee Retention

After the measurement model assessment, the structural model assessment was made, including collinearity, path coefficients, effect sizes and the predictive relevance which is not in-sample. The

collinearity test ensures that no two constructs are overlapping and distinct. The VIFs for the inner model show that most values are lower than the threshold of 3.3, except for one value (Kock, 2015).

Table 5 Collinearity Diagnostic

	EC	ER	T4.0
EC	0.000	1.903	0.000
ER	0.000	0.000	0.000
MS	0.000	0.000	2.260
T4.0	0.000	3.320	0.000
i4.0-A	1.000	2.609	1.984
i4.0-R	0.000	4.554	0.000

Note: i4.0-A = i4.0 Adoption, T4.0 = Trainings 4.0, EC = Employee Competency, MS Management Support, i4.0-R = i4.0 Readiness, ER = Employee Retention

Table 6 shows the sizes and significance of the path coefficients. The hypotheses are tested on the three parameters; i) the p-value must be less than 0.05, ii) the t-statistics must be greater than 1.645 for one-tail testing, and iii) confidence interval ranges must not contain zero. The hypotheses were tested on a two-tailed 95 per cent level of significance. The above table shows all direct, indirect and moderation effects. The straight and specific indirect effect of industry 4.0 adoption on employee retention was found to be significant. The path coefficients of indirect paths through training 4.0 ($\beta = 0.075$, $p < 0.05$) and employee competency ($\beta = 0.075$, $p < 0.05$) were significant and similar in strength. Therefore, it can be suggested that the effect of industry 4.0 adoption on employee retention is partially mediated by training 4.0 and employee competency. However, moderation of managerial support and i4.0 Readiness was found statistically insignificant.

Table 6 Hypothesis Testing

Path Directions	B	SE	t-stat	p-value	Confidence Interval		Decision	
					2.50%	97.5%		
Direct Effect								
H1 i4.0-A -> ER	0.094	0.056	1.671	0.047	0.003	0.188	Supported	
H2a i4.0-A -> T4.0-	0.227	0.065	3.474	0.001	0.106	0.359	Supported	
H2b T4.0- -> ER	0.328	0.077	4.258	0.000	0.182	0.486	Supported	
H3a i4.0-A -> EC	0.431	0.060	7.168	0.000	0.306	0.54	Supported	
H3b EC -> ER	0.173	0.041	4.250	0.000	0.253	0.092	Supported	
Indirect Effects								
H2 i4.0-A -> T4.0 -> ER	0.075	0.028	2.650	0.004	0.032	0.124	Supported	

H3	i4.0-A -> EC -> ER	0.075	0.022	3.368	0.000	0.112	0.039	Supported
Moderation								
H4	MS x i4.0-A -> T4.0	0.016	0.028	0.583	0.280	-0.032	0.060	Not Supported
H5	i4.0-R x i4.0-A -> ER	0.019	0.029	0.634	0.263	-0.037	0.059	Not Supported

Note: i4.0-A = i4.0 Adoption, T4.0 = Trainings 4.0, EC = Employee Competency, MS Management Support, i4.0-R = i4.0 Readiness, ER = Employee Retention

The f-square statistic is employed to assess the magnitude of the association between several constructs investigated in a study (Cohen, 1988). If the value of 0.02, 0.15 and 0.35 are small, moderate and large effect size benchmarks, respectively. Table 7 shows the f-square value of 0.10 of the effect size of EC on ER, indicating a weak effect between these constructs. MS strongly impacts T4.0 as the value is greater than 0.35. The relationship of T4.0 and ER is moderate. i4.0 adoption has a strong impact on EC but weak effects on ER & T4.0. Since the f-square value exceeds, 0.35 There is a strong relationship between i4.0 R and ER.

Table 7 f-squared Values

	EC	ER	T4.0
EC	-	0.10	-
ER	-	-	-
MS	-	-	1.07
T4.0	-	0.18	-
i4.0-A	0.23	0.09	0.12
i4.0-R	-	0.60	-

Note: i4.0-A = i4.0 Adoption, T4.0 = Trainings 4.0, EC = Employee Competency, MS Management Support, i4.0-R = i4.0 Readiness, ER = Employee Retention

The out-of-sample prediction is a newly introduced phenomenon that calculates our model's predictive ability for other samples. When the endogenous variable possesses the predictive ability, the root means squared error (RMSE) of PLS-SEM is typically lower than that of a Linear Model (LM). This implies that PLS-SEM is better suited for predicting the outcome variable as it yields lower error rates than the LM (Shmueli *et al.*, 2019). The analysis systematically evaluates each individual item of the dependent variable. Hence, if the minority items satisfy the requirements, the model exhibits limited predictive capability (Shmueli *et al.*, 2019). Table 8 shows that the Q2 is positive for all items, so PLS predict can be assessed for the data (Hair *et al.*, 2018). Only one item of ER meets the criteria (PLS RMSE < LM RMSE). Therefore, the model has weak out-of-sample predictive power.

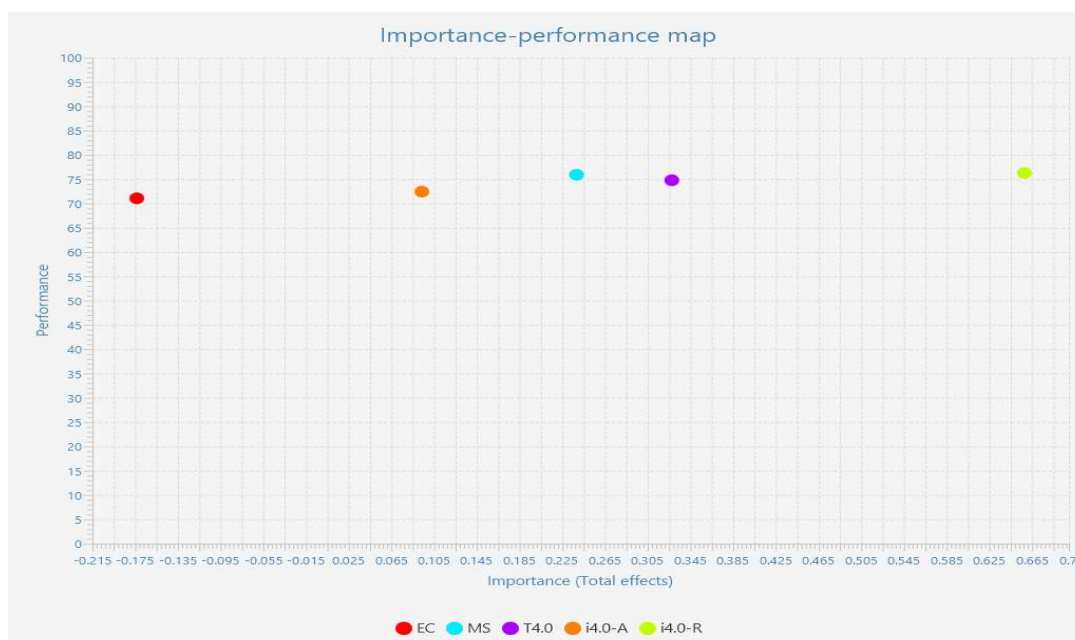
Table 8 PLS Predict – Out of Sample predictive power

Q ² predict	PLS-SEM_RMSE	LM_RMSE	PLS RMSE < LM RMSE?

ER1	0.725	0.498	0.504	Yes
ER2	0.751	0.487	0.462	No
ER3	0.716	0.560	0.538	No
ER4	0.687	0.582	0.552	No

The importance-performance map analysis (IPMA) determines the extent to which an independent variable is important and performs for a dependent variable (Hair, Hult, *et al.*, 2017). Figure 2 shows that i4.0-R is a star performer in explaining employee retention, as it has the highest total effects and performance. At the same time, T4.0 is a variable that needs further research on how its performance can be enhanced to function employee retention more effectively.

Figure 2 Importance Performance Map Analysis



Discussions

This current study was based on the UTAUT model, which states that behaviour (employee retention) is affected by technological change. The factors like training (working conditions) and employee skills (self-confidence of employees) are the primary sources for commitment and continuous use behaviour (retention). Furthermore, the current study also unveils emerging relationships which can be useful for managerial decisions in the era of technology and sciences. The statistical analysis revealed a strong and favourable impact of adopting Industry 4.0 on employee retention. This finding is supported by a recent study by M. Sharma *et al.* (2022). Moreover, the results show that Training 4.0 and Employee Competencies positively mediate in the relationship between Industry 4.0 adoption and employee retention. These findings are in line with previous literature. [Eickemeyer *et al.* \(2021\)](#) state that training related to i4.0 awareness and knowledge can boost the skill set of employees, increasing their stay at the same workplace even after implementing any technological change. In another study [Hernandez-de-Menendez *et al.* \(2020\)](#) state that employee competencies positively influence employee retention. When

employees possess the necessary skills and competencies to adapt to technological changes, their self-assurance increases, and they tend to view these changes as beneficial to their work. This positive outlook often results in greater employee retention within the organization. However, the moderation of managerial support and i4.0 Readiness is not statistically significant for the sample data. The previous studies indicate that the i4.0 readiness can be tested statistically in a different dimension, but this study shows that the i4.0 readiness can be an important factor which may affect employee retention in some other but not as a moderator for the automotive industry (Samaranayake, Ramanathan and Laosirihongthong, 2018). Many previous studies have discussed management support as a moderator, indicating how it moderates investment, social capital, and i4.0 adoption (Franceli and Zilber Turri, 2021). The current statistical result does not support management support as a moderator between i4.0 adoption and training 4.0.

Conclusion

Industry 4.0 is an emerging phenomenon to enhance working conditions, employee behaviour, and ease of work. The current study was conducted to test whether technological adoption facilitates employee retention. While technological changes have been a threat to employability at the same point, the change has undergone many supportive keys to implement a smooth technological implementation process. Hence, the current study reveals that factors like training related to industry 4.0 technologies and enhancing employee competencies for understanding i4.0 technologies can smoothen the adoption process. Employees with particular skills find technological adoption as process efficiency rather than an employability threat. In this era, most companies, regardless of size, must adopt i4.0 to utilize employee skills better and enhance employee retention rate. The current study also shows that training and employee competencies positively affect employee retention. The current analysis is drawn from the data extracted by majorly young employees who are always enthusiastic and willing to adopt new technological changes. Therefore, companies must undergo the i4.0 adoption process by knowing how well their employees are equipped with positivity and relative skill sets. Moreover, the IPMAP analysis has revealed that Industry 4.0 readiness is essential to employee retention. Before adopting, organizations must evaluate the readiness of their company and employees and how much they are ready to adopt the technological change regarding skills, finances, and external surroundings. Although the results drawn from the current study can be an excellent resource for managers to look forward to the industry 4.0 adoption process, some limitations can create resistance. The current study is done in Pakistan's automotive sector, specifically only Karachi's population. Also, the respondents were mainly the managerial and lead positioners who revealed that adopting industry 4.0 could retain an organization's top talent. Still, the labors' opinion was not tapped. The generalizability of the findings can be improved with a wider population from different levels of hierarchy. Since Pakistan is a growing country and coping with myriad issues, adopting i4.0 can be a concern in all organizations.

Therefore, further research can be done to draw results for lower-level employees in the same industry. Moreover, different industries of Pakistan, like nursing, services, and manufacturing, can also be considered an understudy to check whether the same hypothesis can be supported. The current study also cannot discover the dimensions of management support and i4.0 readiness in the understudied industry. Therefore, the constructs above can probably affect different relations to check how these may affect employee retention.

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