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Ranking of Innovation Related Factors Influencing Artificial Intelligence Performance

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Abstract: This paper presents a study on ranking of 27 identified innovation related factors which influencing Artificial Intelligence (AI) performance in UAE. These factors were clustered into four groups namely process innovation; management capabilities; personal expertise and organization structure. A questionnaire was designed based on these factors where respondents were required to gauge the influence of these factors using Likert scale. Respondents were from three UAE organisations which are Dubai Police, Dubai Electricity & Water Authority Dewa, and Emirates Integrated Telecommunications Company. A total of 384 valid responses from the questionnaire survey were analysed for its reliability using Cronbach alpha criterion. Then the data was analysed for its mean score and standard deviation values for each of the factors to determine the rank of each factor and also its influence on the organisation performance. The study found that the mean scores for the factors are in the range from 2.90 to 3.56 while for the average mean score for the groups are from 3.15 to 3.44. the study also found that two factors which are management capabilities and artificial intelligence are highly influencing the organisational performance while the other three factors which process innovation, personal expertise and organisational structure are moderately influencing the UAE organisational performance. The findings of this study will ably provide a better understanding of innovation related factors and how it affects overall performance.

Keywords: Innovation related factors, organizational performance

1. Introduction

Governments all over the world are making various technological advances to improve public service activity and efficiency. Since its inception in 1971, the government of the United Arab Emirates (UAE) has frequently sought innovative ways to improve the country's people's standard of living. The UAE then issued the Gulf's first Action Strategy for Online Government (EGG) for the period 2011-2013. This programme completely transformed the world's political structure (Al-Khouri, 2012). In 2013, the government declared that its Mobile Governance (MG) policy would help the country achieve its 2021 goal. This strategy is also known as the national government. M Policy is a continuation of the previous government's efforts to make public facilities available to individuals 24 hours a day, seven days a week via smart phones. The UAE government believes that good policy directly affects citizens.

The government unveiled the United Arab Emirates Centennial Programme, a new stage for the transfer of UAE administration, based on the UAE's 2021 vision. The United Arab Emirates' centennial programme for long-term growth and development in a variety of fields would be a long-term strategy. The UAE Centennial Plan covers four areas of governance: culture, economy, and society. The country's main goal is to use innovation to achieve the best leadership, education, economy, and communities (Chand, 2017). In other words, the UAE aspires to be the best nation in the world by 2071.

The UAE government is currently working to implement innovations in Artificial Intelligence (AI) strategies that will transform the UAE into a smart, AI-dependent country by 2031 (UAE 2031, 2018). Nonetheless, one of the issues with AI is its rapid advancement, which is being used by UAE organisations in the absence of any empirical studies that support or highlight the issues of such technologies in relation to organisational performance; particularly, given that innovation has become an essential factor in enhancing organisational performance in the current era (Rajapathirana & Hui, 2018). Furthermore, Wade et al. (2017) stated that a lack of innovation in organisations has a negative impact on the organisations' ability to thrive. Furthermore, organisations that lack innovation cannot survive in an age of constant change (Petrie, 2011; Chamorro et al. 2018). As a result, a lack of deep knowledge of organisational innovation does not assist organisations in working in a new, complex environment (Van de Weerd et al., 2016).

The performance of public organisations in the UAE falls short of expectations because there is no consistent follow-up of innovative in organisations, which has a negative impact on their performance (Elbanna, 2013). Since 2007, public organisations have attempted to improve the innovation process in collaboration with internal specialists in order to improve organisational performance; however, this process is still ongoing and requires additional research (AlQubaisi, 2017). Furthermore, the inability to exploit organisational resources is one of the most important ideas in organisational theory, and it is especially important in UAE public organisations given the current resource shortage (Elbanna & Abdel-Maksoud, 2020), such as utilizing innovation to improve organisational performance.

The UAE is one of the top countries investing in innovative technologies to improve organisational performance; however, the UAE's presence in the research field is very slow in comparison to the UAE's rapid growth of innovation technologies in public organisations; this is the main issue and gap that the current research aims to close. Among innovative technologies, much money is spent on promoting AI technologies. As a result, the focus of this research is on identifying and prioritising the Artificial Intelligence factors influencing organisational performance.

2. Literature Review

2.1 Artificial Intelligence

With the computer machine revolution in the early twentieth century, AI and the original AI principle evolved (Meek et al, 2016). The term "artificial intelligence" was coined by John McCarthy in the Dartmouth conference in the United States (Crevier, 1993). AI was aimed to be used in the machines with the same fundamental characteristics as human intelligence for developing complex applications. Shenoy (1985) considered AI as a "dark branch of computer science". Rich and Knight (1991) believed that AI's machines are intelligently doing things like humans and it is distinct from the normal intelligence displayed by humans and other species.

According to Webber & Nilsson (2014), AI is an informatics subset of how machines can be smartly complex. AI is a research development that allows machines to find the best approach to solving complex human-like problems (Kasemsap 2017). Pannu (2015) commented that AI is neither psychology nor computer science because it demonstrates computation. He claims that AI is more durable, secure, faster, copiable, easier to disseminate, more documentable, and capable of performing certain tasks than humans. He claims that AI includes computer science, information technology, mathematics, psychology, linguistics, and philosophy, whereas researchers define AI in a variety of ways. To date, AI has played more chess than humans. Nonetheless, awareness and learning are constantly evolving. Figure 1 depicts the stages of AI development.
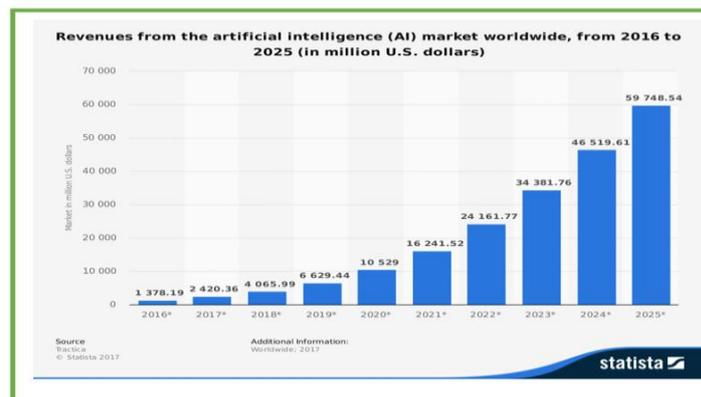

Fig. 1 - The research framework for police departments

There are also an increasing number of AI tests and implementations in their early stages. Furthermore, AI has become more comprehensive and accurate in their understanding and information. Various advanced countries developed AI during the process. When Digital Equipment Corporation became the second largest computer manufacturer in the United States in 1980, XCON (Expert Configure) was founded.

Companies saved $40 million per year after the introduction of Expert Configuration (XCON) (Winston & Prendergast 1984). Since 1985, IBM has been working on Deep Blue, a domain-specific AI chess supercomputer. Deep Blue defeated the reigning World Chess Champion Garry Kasparov on May 11, 1997. This is a significant step forward in the advancement of AI (McCorduck, 2009). The AI was not created solely in the United States but Japan also spent $850,000 in 1982 to design AI computers for a powerful PROLOG system (Shapiro 1983). Germany established a research centre for AI in 1988, at the time of the world's largest non-profit IA research institution. In the third stage, AI thrived due to its rapidly evolving equipment, particularly sensors and chips, as well as Big Data. Several products were developed which such as autonomous robots, stand-alone vehicles, and intelligent computers (Schmidhuber 2007).

2.2 Innovation and Artificial Intelligence

The rapid growth of AI has had a profound impact on the world. Several countries and businesses have launched development initiatives to capitalize on AI's potential (CAICT & Gartner, 2018). The Subcommittee on Science and Technology and Growth Networks and Information Technology initiated the 2016 National System for Strategic Advancement and Artificial Intelligence Research (NITRD, 2016). The United States issued Guidelines of Artificial Intelligence Policies IT Industry Board in 2017 (Dutton, 2018). IT industry council United States of America and President Trump signed an Executive Order outlining a potential path for AI development for the American AI Program in February 2019, which includes funding, open government tools for digital tools, related construction needs, emergency management, and the appropriate international standards. The Chinese State Council issued the Next Century Artificial Intelligence Research Plan in 2017 (Dutton, 2018). In 2018-2020, the UAE's Ministry of Industry and IT announced a three-year Growth Action Plan (Beckett & Ge, 2017; Dutton, 2018). The Japanese government launched an artificial intelligence study in 2017 (Dutton, 2018). The Human Brain project was published by the European Union (Markram, 2012). In 2017, the Institute of Electrical and Electronic Engineers released Ethical Compliant Architecture version 2 (IEEE, 2017). These developments and policies helped to create an ecosystem that fosters AI development.

The most important AI applications are currently linked with Big Data, Visual Help, NLP, and smart robots. The majority of IA technologies are used in business, finance, medicine, and automobiles (CAICT & Gartner 2018). Intelligent patient treatment includes imaging, professional decision-making assistance, speech recognition, drug exploration, welfare management, anatomy, and so on. AI has the potential to provide intelligent solutions. Machine learning, for example, can predict drug production, gene sequencing, and crystal structure. Natural language comprehension aids electronic health studies, intelligent analysis, and assistance. Machine vision can be used to recognize medical images, damage, and self-test skin disease (CAICT & Gartner, 2018). AI has the potential to transform health care by increasing the level of treatment while decreasing therapy costs (Hamet & Tremblay, 2017). Furthermore, big AI technology will drive advancements in financial infrastructure. "Credit assessment, fund management, and financial research will assist the IO in rebuilding the green structure of modern financial business, making financial processes more responsible and educated (banking, insurance, money management, finance, and investment)" (CAICT & Gartner, 2018). Intelligent robots will assist family members, business facilities, doctors, shopping, and recovery. AI has also been applied to smart robots for identification, search and rescue, and firefighters (Alsamhi et al, 2018), education and wellness, financing and robotics (Timms, 2016), and automotive manufacturing (Kusiak, 2017; Meiring &Myburgh, 2015).

2.3 Organizational Performance and Artificial Intelligence

There are various factors that influence the use of innovation technologies in organizations such as the use of AI-related innovations to improve organizational performance. AI-related innovations and new technologies are used to influence customers in order to improve the firm's organizational performance (Grgecic et al., 2015). On the other hand, innovative technologies aim to gain consumers, which necessitate a greater focus on their values and actions during the planning process for implementing any technological innovation in the organization.

The technical aspect of using AI-related innovation technologies to support organizational performance is critical. According to Olesen (2014), organizational technical factors such as different stakeholder groups, technological features, and incongruity within and between stakeholder groupings are incorporated to support organizational performance. As a result, IT-related innovations must concentrate on technical elements in order to support organizational performance. The successful implementation of AI innovations such as cloud computing is influenced by technological readiness, high managerial support, and organizational size (Oliveira et al. 2014). To succeed in achieving better organizational performance, using AI-related innovations to support organizational performance necessitates an understanding of the organization's technical capabilities.

Furthermore, human factors may influence the use of AI-related technologies in the organization. Many individual researchers have discussed the perspectives of individuals with various target areas. Understanding AI technology is a key factor in implementing such technological innovations in organizations (Aggarwal et al. 2015). Furthermore, the system's technological skills influence the organization's use of AI-related innovations (Aggarwal, 2015; Klaus et al., 2015; Kummer al., 2017). As a result, if the human factor or individuals' technological skills and knowledge are not taken into account, the use of AI-related innovations in organizations may not help to improve organizational performance.

Organizational variables at the manager, group, and business levels influence the use of AI innovations in the organization such as the costs of transitioning from old to new technologies (Van de Weerd et al., 2016). The team atmosphere is one of the major organizational variables associated with using AI technologies, and scholars have discovered that a common goal, support for innovation, security of participatory interaction, and feedback would alter cognitive perceptions and improve use of innovation technologies (Maruping & Magni, 2012; van de Weerd et al., 2016). The climatic and cultural conditions at work, as well as management and top management policy, may all have an impact on the performance of AI-related technologies in the organization (Oliveira et al. 2014).

Social factors influencing the performance of AI innovative technologies have been investigated from a variety of perspectives at the organizational level. Strong rule pressures such as laws and procedures, as well as everyday working challenges such as work culture, are among the factors that inhibit the performance of innovation technologies, whereas social qualities such as professional readiness have a positive effect on the performance of AI innovative technologies in the organization (Choudrie & Zamani, 2016). Besides these, there are various external variables, such as business demand and strategic acceptance, as well as internal considerations, such as top management funding and group size, that influence the performance of innovative technologies, such as AI technologies, in the organization (Oliveira et al., 2014).

Schwab (2016) emphasized the importance of innovative AI technologies in catalyzing discontinuous changes across a wide range of industries. Discontinuous change occurs as a result of creative destruction, a term popularized by Schumpeter (1998), which involves the development of radical innovations (such as Artificial Intelligence) that have the potential to revolutionize the entire economic and operating system. Recent advances in artificial intelligence (AI) have led to advancements in the fields of speech, image recognition, and analysis, allowing machines to perform a wide range of tasks that would normally require human intelligence. Machine learning (ML), a subset of artificial intelligence, includes the ability to learn from practice through computers using various algorithms without being directly trained. Thus, machine learning is recognized as one of the most significant developments in many industries today (Brynjolfsson & Oh, 2012).

Researchers emphasized that rather than being automated, innovation and AI technology should be viewed as collaborators and partners used to improve human skills and organizational performance (Davenport & Kirby, 2015). AI will create new, unprecedented professions through its innovative and emerging technologies. The new jobs will primarily be created to train, explain, and maintain AI-based technology (Wilson et al., 2021). AI innovation is broadly categorized into three groups as process automation, cognitive understanding, and cognitive participation, bolstering the roles of innovative AI-related technologies in organizations (Davenport & Kirby, 2015). Process automation combines multiple information technology (IT) systems that use AI-based systems to input and transfer large amounts of data. To identify patterns and interpret massive amounts of data for improved decision-making, cognitive insight requires the integration of AI-based technologies. Cognitive engagement includes the use of the AI subfield natural language processing (NLP), which allows technologies to interact with people and has the potential to significantly improve organizational performance (Davenport & Kirby, 2015).

In essence, the organizations have paid increased attention to AI technology innovations in order to improve organizational performance. In general, there are various AI-related factors that can either support or hinder the performance of these technologies in organizations. Technical skills, human or staff technological skills, organizational and management support for implementing such new innovations, and social factors such as organizational culture and strategies are among these factors. These AI technology factors improve the performance of these technologies, which leads to improved organizational performance. Comprehensive review of literature resulted in identifying several AI factors which are categorized in five groups of as Process innovation, Management capabilities, Personal expertise, Organization structure, and Artificial Intelligence as presented in Table 1.

Table 1 - Factors influencing innovation

Code	Factors' description	Source
Process innovation		
PI1	Organization improves business to meet the client's desires	Möldner et al., 2020; Sjödin et al., 2020; Rogers et al., 2006; Tidd & Bessant, 2020
PI2	Organization focuses on providing improved services.	
PI3	Organization focuses on using novel ideas to lower the services cost.	
PI4	Organization follows up-to-date ways to increase the value of services.	
PI5	Organization utilizes innovations that focus on cutting costs.	
PI6	Organization has a good system to reach distant customers.	

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Management capabilities		
MC1	Organization management supports innovation.	
MC2	Organization management practice empowerment	Ollila & Yström, 2020; Lei et al., 2020
MC3	Organization supports inventive employees.	
MC4	Organization encourages employees to provide innovative ideas.	
MC5	Organization provides innovative employees with adequate resources to allow ideas to arise.	
Personal expertise		
PE1	Organization has expertise to support innovation process.	
PE2	Organization focuses on training employees to enhance the innovation of the organization.	Campos-Blázquez et al., 2020; Sopa et al., 2020
PE3	Organization pays attention to knowledge of employees to enhance innovation in the organization.	
PE4	Organization has highly educated employees.	
PE5	Organization has highly experienced employees to support innovation in the organization.	
Organization structure		
OS1	Organization encourages team work to enhance innovation.	
OS2	Organization values group work to discuss innovative ideas.	
OS3	Organization supports open culture of innovation.	
OS4	Organization encourages participative mode of work to improve the innovation of the organization.	Waruwu et al., 2020; Klaic et al., 2020
OS5	Organization focuses on collaboration work style to make the organization more innovative.	
OS6	Organization encourages the implementation of innovative ideas among the groups of the employees.	
Artificial Intelligence		
AI1	Organization uses Artificial Intelligence technologies to enhance its performance.	
AI2	Organization prepares to use novel AI technologies in its services.	Grgecic et al., 2015; Olesen 2014; Oliveira et al., 2014; Aggarwal, 2015; Klaus et al., 2015; Kummer al., 2017
AI3	Organization implements up to date AI technologies to serve the needs of customers.	
AI4	Organization has AI technical team to enhance the services.	
AI5	Organization has skillful experts in AI to provide innovative ideas for the provided services.	

3. Methodology

The quantitative method was adopted for data collection in this study. Questionnaire survey was conducted with the help of a five-point Likert scale. The measurement scale in this study describing Likert scale was S.D. = Strongly Disagree; D. = Disagree; M. = Moderately Agree; A. = Agree; and S.A = Strongly Agree. Respondents for this study came from three organisations in the UAE, all of which are based in Dubai: Dubai Police, Dewa, and Du. The total population of these organisations is as 17,000 for Dubai Police, 11,000 for Dewa, and 2,800 for Du. These organisations employ a total of 30,800 people. The sample size for this study was determined based on the population using Krejcie and Morgan's sample size determination table (Krejcie& Morgan, 1970), which resulted in a sample size of 380 respondents. The questionnaire for this study was distributed using a non-probability simple random sampling technique. A total of 384 valid responses were collected which were more than required number of samples. The demographic information provided by respondents describes the characteristics of the study sample. The current study's participant background information includes age, years of experience, and position, as shown in Table 2.

Table 2 - Respondents' background information

Age	Percentage %
20- 30	31%
31-40	29%
41-50	20%
≥ 50 years	20%
Working Experience	**Percentage %**
≤ 5 Years	36%
6-16 years	39%
16-25 years	15%

	Position	Percentage %
≥ 26 years		10%
Manager		11%
Executive		35%
Worker		54%

In terms of age, the table above shows that 31 percent of respondents are between the ages of 20 and 30, 29 percent are between the ages of 31 and 40, 20 percent are between the ages of 41 and 50, and 20 percent are over 50. Working years of 5 years account for 36% of the total, 6-16 years account for 39%, 16-25 years account for 15%, and 26 years account for 10%. In terms of position, managers accounted for 11%, executives for 35%, and workers for 54%.

4. Results and Discussion

4.1 Reliability Assessment

To be dependable, multiple item structures must be internally consistent. When repeated measurements are taken on the variable of interest, reliability refers to the degree to which the research measurements are free of random error and the extent to which a scale used produces consistent results (Pallant, 2011). The most widely used reliability metric is Cronbach's alpha. Cronbach's alpha is a measure of a measuring scale's dependability. Cronbach's alpha must be greater than 0.7 in order to achieve internal consistency (Hair et al. 2011; Wong 2013). The Cronbach's Alpha reliability values are shown in Table 3 below.

Table 3 - Cronbach's Alpha reliability test

No.	Constructs	Number of factors	Cronbach's Alpha
1	Process innovation	6	0.873
2	Management capabilities	5	0.807
3	Personal Expertise	5	0.824
4	Organization structure	6	0.896
5	Artificial Intelligence	5	0.873

Table 3, shows the results of the overall perception scale reliability of all dimensions. It revealed that the scores are having good internal consistency with alpha values above 0.7, indicating that the survey's internal consistency is good.

4.2 Ranking of Factors

In the ranking analysis, the rank for each factor is decided based on the mean score of each factor and if there are more than one factors are having same mean score, then the rank will be decided on the standard deviation score of the factor. For factor having less standard deviation value, it means that the homogeneity of the respondents giving the same score this give better rank. The following figures are the results of the ranking analysis for each groups of the system process innovation.
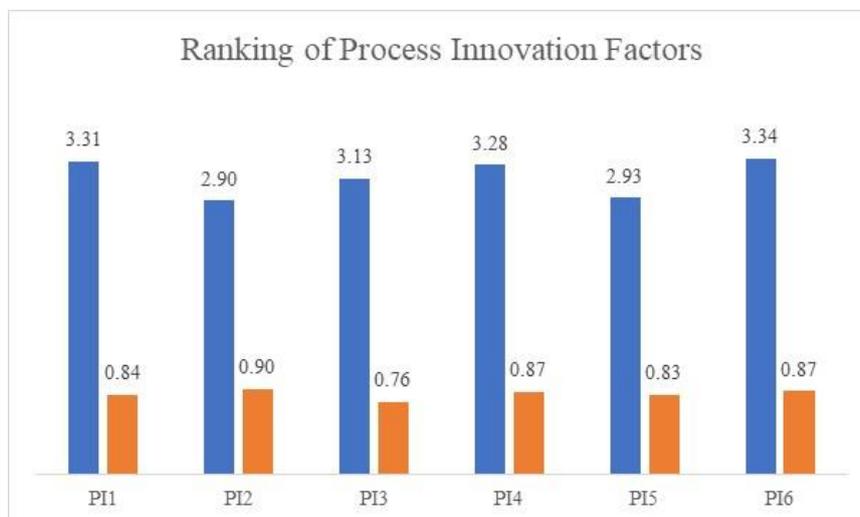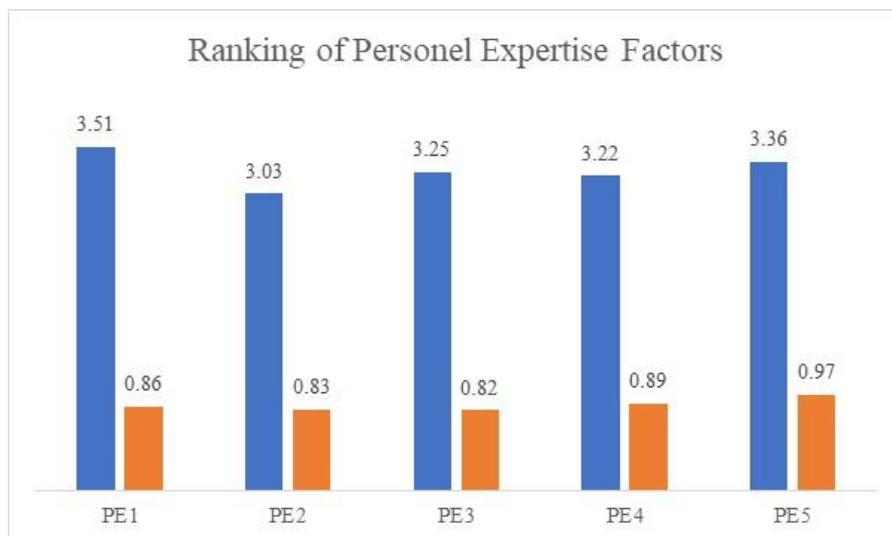

Fig. 1 - Process innovation factors

According to Figure 1, the factor P16, i.e. the organisation has a good system to reach distant customers, is the top ranked factor influencing organisational performance in the category of process innovation. This is followed by the organisation improving its business to meet the needs of its customers. This is true because the organisational system is critical to maintaining performance. According to the respondents, the lowest ranked factor among process-related factories is an organisation that focuses on providing better services. Similarly, the ranking of the management related factors is presented in figure 2.
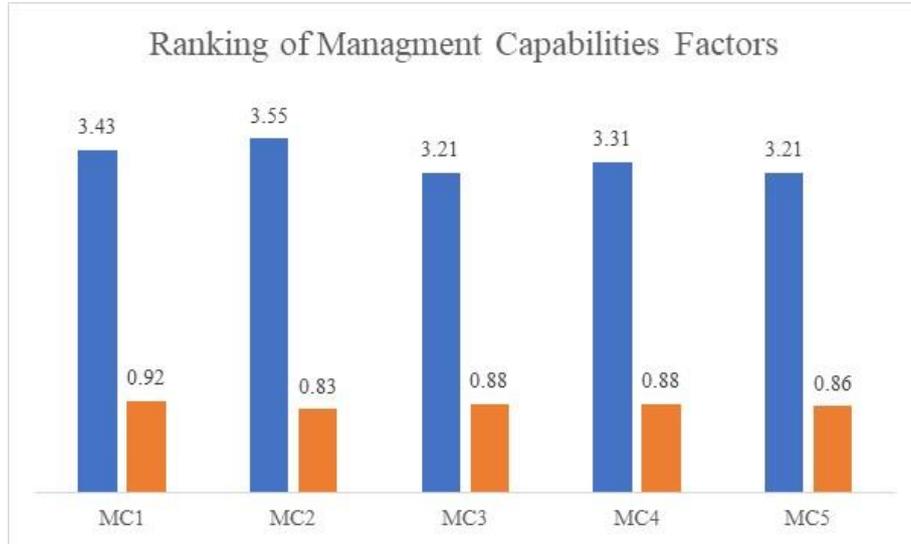

Fig. 2 - Management capabilities factors

According to Figure 2, the respondents placed the factor MC2, i.e. organization management practice empowerment at the first place with highest mean value. The factor MC1 i.e. Organization management supports innovation is reported as the second top ranked factor in this category. It is very essential to have effective organizational system. The participants involved in the survey ranked the factors "organization supports inventive employees" and "organization provides innovative employees with adequate resources to allow ideas to arise" at the lowest place. The ranking of the personnel expertise related factors is presented in figure 3.


Fig. 3 - Personel expertise factors

Figure 3 depicts that the factors PE1 i.e. organization has expertise to support innovation process is the top ranked factor among the personal expertise related factors in influencing the organizational performance in the UAE. The

factors PE5 i.e. organization has highly experienced employees to support innovation in the organization is the second ranked factors reported by the participants of this survey. The respondents mentioned that the factor PE2 i.e. organization focuses on training employees to enhance the innovation of the organization is the lowest ranked factor in the category of personal expertise related factors. The organization structure related factors were also investigated to prioritize as presented in figure 4.
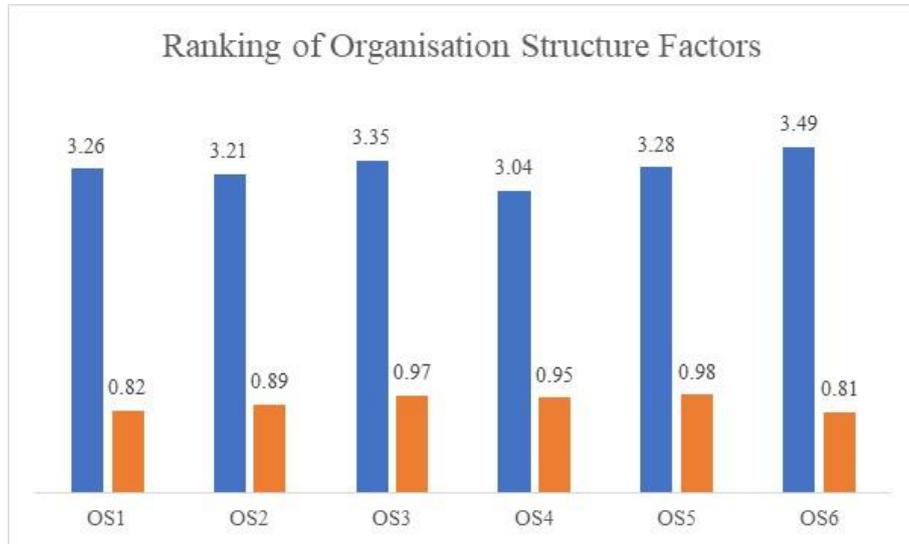
Fig. 4 - Orgainastion structure factors

Figure 4 demonstrates that the respondents participating in the data collection reported that the factor OS6 i.e. organization encourages the implementation of innovative ideas among the groups of the employees is the first ranked factor with highest mean value of 3.49. The factor OS3 i.e. organization supports open culture of innovation is placed at second rank with the mean value of 3.35. The respondents placed the factor OS4 i.e. organization encourages participative mode of work to improve the innovation of the organization as the least important factor in the category of organization structure factors influencing the organizational performance. The factors of artificial intelligence were also assessed and ranked based on mean value as summarized in figure 5.
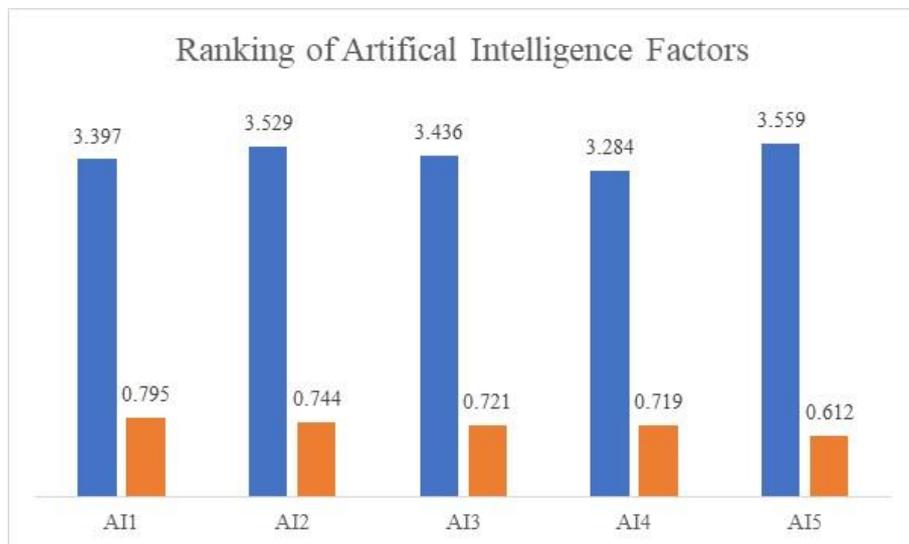
Fig. 5 - Artifical intelligence factors

Figure 5 shows that the factor AI5 i.e. organization has skillful experts in AI to provide innovative ideas for the provided services is the top ranked artificial intelligence related factors as perceived by the respondents. The factors

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AI2 i.e. organization prepares to use novel AI technologies in its services is reported as second ranked factors in influencing the organizational performance. The results shows that the least important factors in the artificial intelligence is AI4 i.e. organization has AI technical team to enhance the services.

4.3 Decision on Level of Influence

The section determine the level of influence of each of the four groups of innovation related factors toward the organisational performance. The determination of the groups is based on table 4 which give the range of decision according to the average mean score for each of the group (Memon, et.al. 2011).

Table 4 - Response evaluation criteria

Score	Descriptors	Meaning	Mean Interval
1	Strongly disagree	Very low	1.00-1.80
2	Disagree	Low	1.81-2.60
3	Neutral	Moderate	2.61-3.40
4	Agree	High	3.41-4.20
5	Strongly agree	Very high	4.21-5.00

Using the average mean score attained by each group and the decision criteria as in tabl 4, the results of the level of influence of each group on the organisational performance are as in table 5.

Table 5 - Result of factors influencing organisational performance

System process innovation factors group	Number of factors	Overall mean score	Decision on influencing organisational performance
Process innovation	6	3.146	Moderately
Management capabilities	5	3.342	Highly
Personal expertise	5	3.275	Moderately
Organization structure	6	3.271	Moderately
Artificial Intelligence	5	3.441	Highly

The overall mean values of the system process innovation factors are in the range of 3.146 to 3.441 as in Table 5. This table shows the decision of each factor in influencing the organisational performance using the decision scale as in table 5. The results indicate that two facors which are management capabilities and artificial intelligence are highly influencing the organisational performance while the other three factors which process innovation, personel expertise and organisationa structure are moderately influencing the UAE organisational performance.

5. Conclusion

This study identified and prioritised the AI innovation factors that influence organisational performance. The study was conducted quantitatively, with 384 valid responses collected and analysed. By confirming multicollinearity and singularity, the data was validated. The consistency of the data was also confirmed using the Cronbach Alpha value. The data mean analysis revealed that all of the innovation factors are moderate, with minor variations, with management capabilities rated 3.342, personal expertise rated 3.274, organisational structure rated 3.270, and process innovation rated 3.146. Statistical analysis of the factors revealed that the factor P16, i.e. the organisation has a good system to reach distant customers, is the top ranked factor influencing organisational performance in the category of process innovation. The factor MC2, i.e. organization management practice empowerment is the tope ranked factors in the category of management capabilities. Among the factors related to personal expertise, PE1 i.e. organization has expertise to support innovation process is the top factor. OS6 i.e. organization encourages the implementation of innovative ideas among the groups of the employees is the first ranked factor while among AI related factors, AI5 i.e. organization has skillful experts in AI to provide innovative ideas for the provided services is the top ranked factors. This research is critical for academics to comprehend the nature of organisational innovation and its impact on organisational performance. Understanding organisational innovation necessitates a constant search for emerging technologies, tools, and skills that can help organisations perform better. One of the policy implications is that in order to maintain better organisational performance, policymakers must evaluate a variety of mutually beneficial innovation factors. That is, the current study proposes four independent variables that must all be considered concurrently because focusing on some characteristics while ignoring others may not help to improve government performance.

Acknowledgement

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