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A strategic model-based of micro-moment data in smart cities especially internet of things

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Abstract

Many industry leaders predict that the industrial Internet will create unprecedented levels of growth and productivity over the coming decades. Business leaders, governments, academic environments, and technology vendors are working hard together to realize and restrain this powerful potential. In this research, the combined method has been used. In the qualitative part, the foundation data method or grounded theory with a systematic approach which attributed to Strauss and Corbin has been used for data analysis and has been designed with three open, axial and selective coding techniques in Maxqda model software. Then, the questionnaire was designed in 6 dimensions: causal, axial phenomenon, prevailing context, intervening conditions and consequences in 50 items to confirm the dimensions, components and indicators. The statistical population is consist of 35 managers and basic technology senior experts in the Internet of Things (IOT) field, marketing and information technology experts who have been selected by Snow Ball method (chain reference) to the theoretical saturation limit. In the quantitative part, after identifying the relevant dimensions, components and indicators, the questionnaire was provided to managers and experts. The results were confirmed by independent t-test. Prioritization of dimensions and components has been done by AHP technique. Reliability of interviews with Cohen's Kappa coefficient and inter-rater reliability method, content validity of the questionnaire using content validity ratio (CVR), content validity index (CVI), apparent validity with item impact scores and reliability with Cronbach's alpha and halving method has been approved.

Keywords: Internet of things, 4 industrial revolution, Smart city, Real time marketing

1. Introduction

The appearance of the platform will transform every part of the economy and society as a whole part of education, media, jobs and professions to health care, energy and government [1, 2, 3, 4]. How can we provide tools and services that facilitate interaction between producers and consumers

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in motivational ways? In this respect, platforms interactions are similar to any social or economic exchange that takes place either in the virtual world or in the real world[5, 6, 7]. In any transaction, the producer and the consumer exchange three things: information, goods or services, and some kind of currency or money. The central core of the interactions is the design of the platform or its architecture, although some have more complex models, but the core structure is kept the same (Parker et al., 2016)[8, 9, 10].

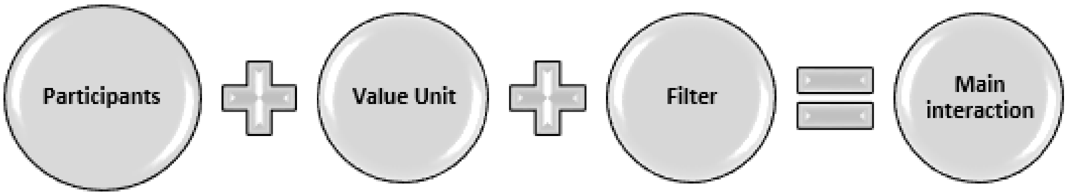

Figure 1: Core structure of interactions

General Electric (GE) coined the term industrial Internet for Industrial Internet of Things (IIOT), and other companies, such as Cisco, called the Internet of everything, others called it fourth revolution, and many other different names were chosen by others. However it is important to distinguish IOT vertical strategies such as consumer, trade, and industrial Internet forms from the broader horizontal concept of the IOT (Gilchrist, 2016)[11? , 13, 14].

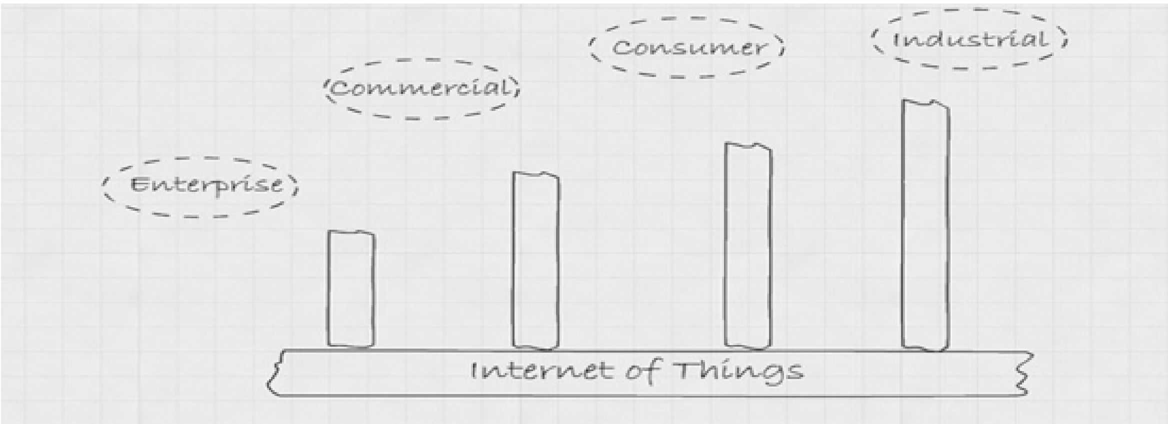

Figure 2: Vertical and horizontal aspects of the Internet of Things (Gilchrist, 2016)

CPS is a new paradigm for Network/Distributed Control System (NCS / DCS). It defines the common collaboration and design between a large number of IOT devices and real-world objects connected through a distributed network[15]. At the same time, CPS can monitor and create real-world processes so that we can understand the feature and conditions of each process, control related objects and make the right decision at the moment. As a result, productivity will increase significantly and costs, wrong rate and waste will be significantly reduced.

Table 1: Installed IOT infrastructures based on classification (million units)

Classification	2016	2017	2018	2020
Consumer	3963	5244.3	7036.3	12863
Business: Parallel Industries	1102.1	1501	2132.6	4381.4
Business: Vertical Industries	1316.6	1635.4	2027.7	3171
Total	6381.8	8380.6	11196.6	20415.4

Inspired by Software-defined Networking (SDN) and service-oriented architecture, we propose CPSS, which divides CPS into three layers: Infrastructure as a service (IAAS), network as a service (NAAS), and application as a service (AAAS).). At the same time, we divide the CPS domain, which defines the application of each CPS module and draws a map between the real and virtual worlds. This means that when an application feels it has insufficient resources, you can turn to another infrastructure for services. (Yova et al., 2019)[16, 17, 18, 19]. According to the magazine of the world of economy in October 2020, a study by Markets & Markets predicts that by 2023 the global IOT banking and financial services market will grow from $249.5 million to $2.03 billion. This number represents an eightfold growth in just five years or a compound annual growth rate of 52%. The IOT technology market in the retail industry is also expected to reach $35 billion by the end of this year. Huawei Company has been following the implementation of \1 + 8 + N" strategy with its ecosystem design, which it has been talking about for more than a year. Ecosystem is a flawless communication based on artificial intelligence between smart devices, with a user's smartphone at its heart, and can communicate with 8 smart devices such as personal computer, laptops, tablets, watches, and wearable clothing. N is also one of the countless IOT-enabled devices that complete it by connecting to this ecosystem. The central control of such an ecosystem is through Huawei hardware[20, 21, 22, 23].

Hundreds of smart city projects have developed around the world. The goal of smart cities initiatives is to provide more effective services to citizens, monitoring and improving the existing infrastructure, and also seeks to increase collaboration between different economic actors and promote innovative business models in both the private and public sections. In 2014, Angelidou called the first, hard smart city strategies (smart buildings, intelligent energy grids networks, water management, smart mobility) and the second, soft strategies (expanding social and human fund through education, culture, social learning, and social innovation[24, 25]).

Bill Hutchison introduced a pentagonal pyramid called the Intelligent Community Open Architecture (i-COA). The first two levels correspond to the hard strategies of the smart city (places and infrastructure) and the top three levels (collaboration ecosystem, applications and life) correspond to the soft strategies. This framework deserves to be built because it is easily portrayed and defines the ultimate goals of smart cities, which are not limited to infrastructure and hardware communication, but also create a collaborative environment while it has the ability to grow innovation and quality of life[**?** 29].

All of these models owe to the main classification of the features of the 6-dimensional smart city of Giffinger et al. in 2007 which includes quality of life (smart life), competitiveness (smart economy), human and social fund (smart people), social and public services and citizen participation (smart governance), transportation and communication infrastructure (smart movement) and natural resources (smart environment). To better understand, we propose to integrate the Giffinger and Hutchison frameworks to realize collaboration ecosystems growth by smart city which ultimately result in improving life standards and the competitiveness of urban spaces (Paoloapiva et al., 2018)[28, 29, 30, 31].

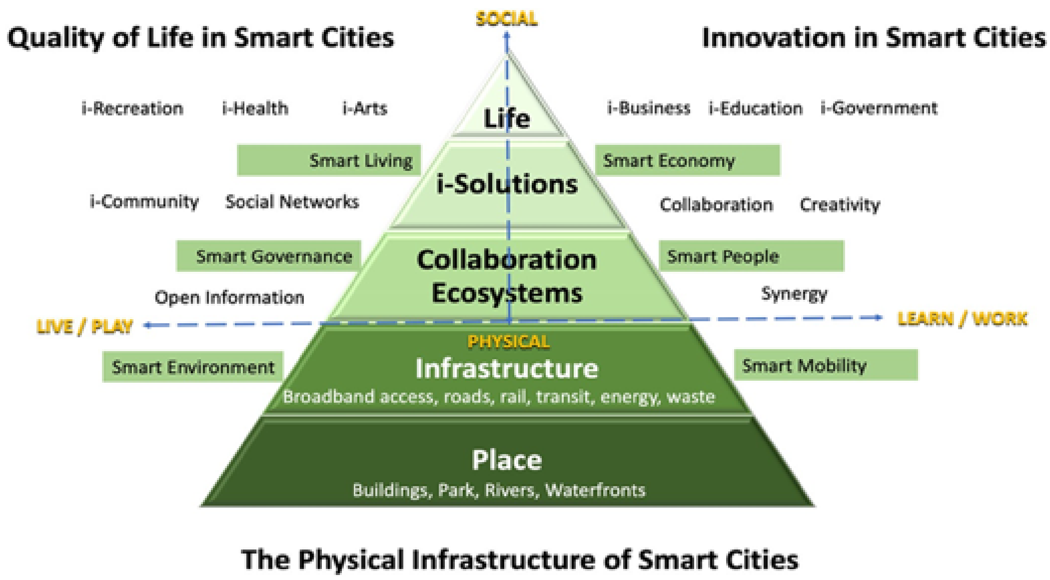

Figure 3: An adaptation of Hutchison's i-COA® framework highlighting Giffinger's smart city elements [30].

In fact, according to Hutchison model, any smart city project should start with physical infrastructure (smart environment and smart movement). This is the foundation of creating an innovation ecosystem based on social and human fund (smart economy and smart people)[32, 33].
Researchers have studied different parts of the smart city. Figure 4 shows the 100 words that the smart city literature which is based on 2856 articles as the degree of representation is measured by the Latent Dirichlet Allocation (LDA) method, which is a powerful and widely used technique for understanding the topics of a set. The font size of a word in Figure 4 is proportional to the degree of representation of the subject in the word distribution in the set, which is measured by the LDA method for a subject in the whole set (in this case "smart city")(Lim et al., 2018)[34, 35, 36, 37].

The Latent Dirichlet Allocation (LDA) method is developed to model a number of latent variables (titles) in a set of texts that contain words. In fact, in a text containing a number of words, each word can be assigned a number of titles with a certain probability, which ultimately combine to form a text and its title.

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Figure 4: 100 top words of smart city literature using modeling method [36].

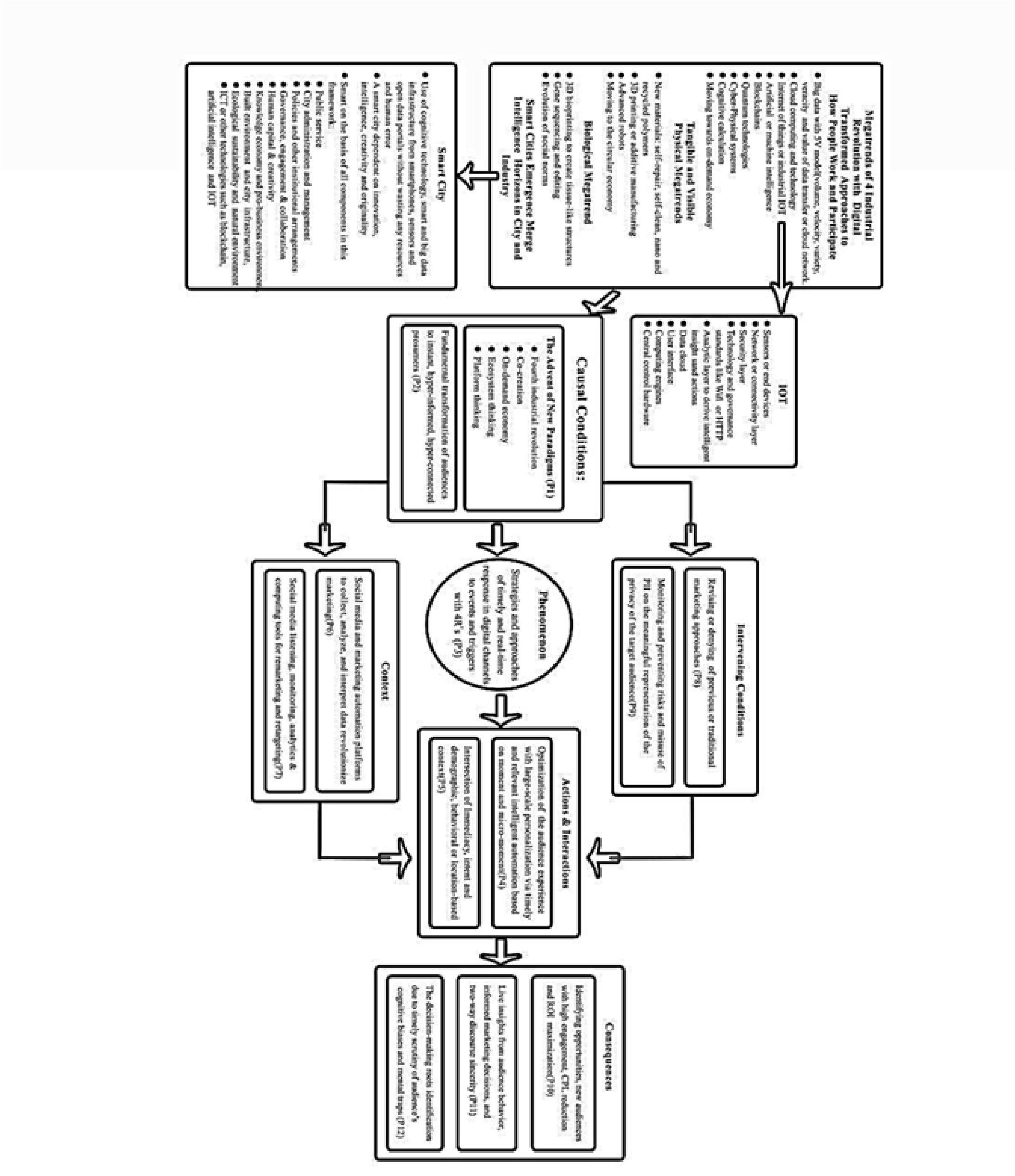

Figure 5: Diagram of Paradigm model of IOT-based marketing in the smart city in the fourth industrial revolution [37]

2. Research methodology

The obtained data have been analyzed using descriptive and inferential statistical methods. Independent t-test was used to confirm the results, which was less than 0.05 due to the significance level of all criteria and sub-criteria and was confirmed. Priorities are determined by the Analytic Hierarchy Process (AHP)[38, 39, 40, 41, 42]. First, the weights of pairwise comparisons were calculated using the Buckley geometric mean method and given to 10 respondents. After answering, the incompatibility rate was all less than 0.1, which indicates the stability and reliability of pairwise comparisons[43, 44, 45].

All dimensions, components and indicators obtained from the foundation data method are organized in the form of a questionnaire in six categories of causal, axial (phenomenon) conditions, governing context, intervening and consequences. To check the validity, it has been distributed among 20 experts and its content validity has been confirmed by using the content validity ratio (CVR), content validity index (CVI) and apparent validity of the item impact scores[43, 44, 45, 46]. The reliability of the interview was confirmed by Kappa method and inter-rater reliability and for the reliability of the questionnaire was confirmed by Cronbach's alpha and halving method. SPSS & Super-decision statistical soft wares were used to analyze the data of this research at the inferential level[46, 47, 48, 49, 50, 51, 52]. According to the results, 57.1% of the respondents have studied in the field of digital and 42.9% in the field of marketing [53, 54, 55, 56, 57]

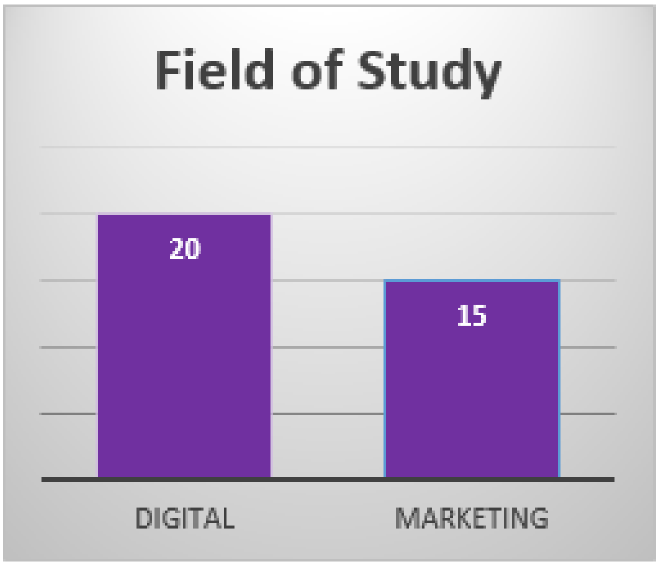

Figure 6: Chart of Respondents' field of study

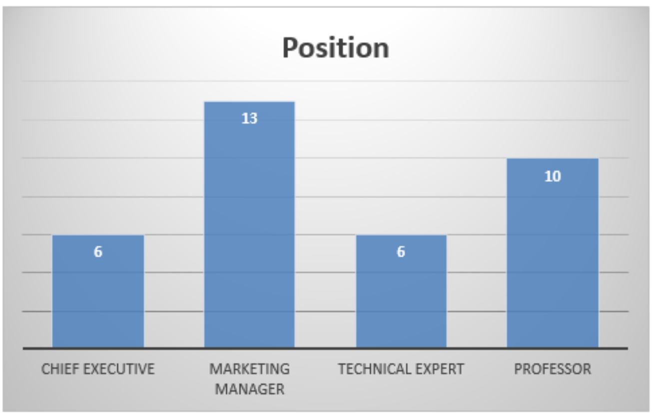

Figure 7: According to the results, most of the respondents, i.e. 37.1%, were in the position of marketing manager.

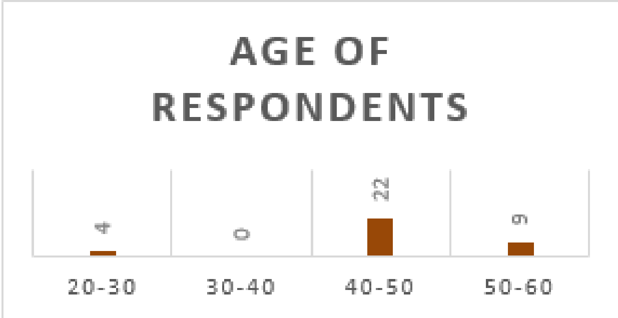

Figure 8: Age of respondents

According to the results, most of the respondents, i.e. 62.9%, belonged to the age group of 40-50 years.

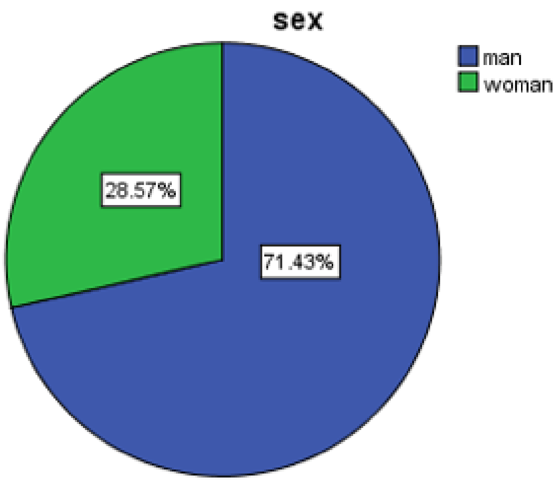

Figure 9: Circular chart of respondents' gender percentage

According to the results, 71.4 respondents were male and 28.6 respondents were female.

2.1. Confirmation of indicators by independent t-test

At this stage, after identifying the relevant dimensions, criteria and sub-criteria, the questionnaire was given to 35 managers, experts and professors and the results were analyzed using independent t-test. In independent t-test, if the level of significance of the research statistic is less than the level of research error (0.05), it can be said with 95% confidence that the criteria are approved. According to the above chart, the significance level of all criteria and sub-criteria is less than 0.05 and therefore are approved.

2.2. Results of AHP method

In this step, at first level, pairwise comparisons of criteria were formed and provided to 10 respondents. After answering the pairwise comparisons, the incompatibility rates of the tables were calculated, all of which were less than 0.1, which indicates that the stability and reliability of the pairwise comparisons are acceptable. Then, the answers were merged using the geometric mean method in the form of paired comparisons which is given below. The weights of pairwise comparisons are also calculated using the Buckley geometric mean method. To evaluate the validity of the questionnaire from two content perspectives with content validity ratio (CVR), content validity index (CVI) and for apparent validity of the test, item impact scores have been used.

2.3. Content Validity Ratio (CVR)

Content validity is a structural feature of the measurement tool that is woven into it at the same time as the test.

$$CVR = \frac{N_e - N/2}{N/2} \tag{2.1}$$

If the calculated value is greater than the value of the CVR decision table, the validity of the content of that item is accepted (Hajizadeh and Asghari, 2011). According to the table, the content validity criterion is acceptable for all questionnaire questions in the range.

2.4. Content Validity Index (CVI)

Waltz & Bausell (1981) method is usually used to calculate this index.

$$CVI = \frac{\text{Number of specialists who gave the item a score of 3 and 4}}{\text{Number of specialists}} \tag{2.2}$$

If the value obtained is higher than 0.79, it is acceptable, and if the value obtained is less than 0.79, that item is deleted. Content validity index for all questionnaire questions is higher than 0.79 and is acceptable.

2.5. Apparent validity of the questionnaire

To assess impact scores, participants are first asked to rate the importance of each item in a 5-part Likert scale, from 1 (not important at all) to 5 (absolutely important). Impact scores are then calculated using the following formula:
Significance × frequency (percentage) = impact score
To accept the apparent validity of each item, its impact score should not be less than 1.5, and only questions with an apparent validity score higher than 1.5 are acceptable. In the population of 20 people selected in the present study and calculating the impact score for all research variables and the acceptability of the impact score (above 1.5 or confirmation of 80% of the population) for the variables, the apparent validity of the variables was confirmed.

2.6. Reliability from a quantitative perspective

For the reliability of the interview, the kappa method and inter-rater reliability were used and for the reliability of the questionnaire, the Cronbach's alpha and halving methods were used.

Table 2: Installed IOT infrastructures based on classification (million units)

	Value	t amount	standard error	Significance level
Amount of agreement (kappa)	0.666	6.409	0.090	0.000

According to the results of the table, the kappa coefficient is equal to 0.666, which indicates an acceptable agreement between the evaluators. Also, the significance level was equal to 0.000, which indicates the acceptable value of kappa coefficient.

2.7. Questionnaire reliability

After extracting the dimensions, components and sub-criteria with the foundation data method, a questionnaire has been designed and used to measure the reliability of Cronbach's alpha and halving methods.

Cronbach's alpha

$$\alpha = \frac{k}{1-k}\{1 - \frac{\sum s_i^2}{s_x^2}\} \tag{2.3}$$

The results of alpha test for the questionnaire of this research shown that Cronbach's alpha coefficient for the variables is more than 0.7, so the variables have enough reliability.

Halving method

Based on the table above, it is determined that the alpha value for all structures has a value higher than 0.7, which indicates the validity of the questionnaire, appropriate and equal perception of the respondents for the content of the variables related to each structure. Also, the value of Spearman-Brown coefficient in the halving method is equal to 0.937, which indicates the high reliability of the questionnaire.

3. Conclusion

1. Using the Internet of Things to communicate in all departments. Fourth industry for agile, direct, transparent, and visible operations is a supply chain that, by merging with the Internet of Things, will be a transformational jumping platform.
2. Increasing dependence on cloud technology and its positive results in the future. Fourth industry Supply Chain is a data production machine that constantly provides insight for instant access when it requires incredible speed and accuracy. These demands are best provided in the cloud. Cloud technology with central data inputs and resources enables communications and collaborations across critical stages such as supply, planning, production and transportation.

Future work

1- Intelligent infrastructure - Cities must provide the conditions for continuous development. Digital technologies are increasingly developing and urban infrastructure and buildings must be planned more efficiently and sustainably. Investing in electric machines and self-propelled vehicles can keep carbon dioxide levels as low as possible. Intelligent technologies can be used for environment with high efficiency in energy storage. Intelligent lighting that is activated when people pass is the appropriate approach.

References

[1] L. Calderoni, A. Magnani and D. Maio, *IoT Manager: An open-source IoT framework for smart cities*, J. Syst. Arch. 98 (2019) 413–423.

[2] ARC Advisory Group, *Five key Industry 4.0 Technologies*, (2020). www.ottomottors.com

[3] J. Spungin and F. Lauren, *Relearning Creativity for Business Impact*, London Business School ,Translated by Rezaei Maryam,Donyaye Eghtesad Newpaper, 2019.

[4] M. G. Jacobides, *On Ecosystems and Egos*, London Business School Translated by Rezaei Maryam, Donyaye Eghtesad Newpaper, 2019.

[5] M. G. Jacobides and D. J. Atkinson, *The Future is Platforms*, London Business School Translated by Rezaei Maryam, Donyaye Eghtesad Newpaper, 2018.

[6] D. M. Scot, *PR. & Real Time Marketing*, 2011.

[7] D. J. Varòn, M. E. Langa, J. V. T. Miquel and M. C. F. Madrid, Advance in the Area of Marketing and Busines Communication, 2015.

[8] F. P. Appio, M. Lima and S. Paroutis, *Understanding Smart Cities: Innovation ecosystems, technological advancements, and societal challenges*, Tech. Forec. Social Change, 142 (2019) 1–14.
[9] M. Labied, *The Internet of Things and Advanced Analytics are Revolutionizing the Manufacturing Industry*, 2016.
[10] A. Gilchrist, *Industry 4.0: the Industrial Internet of Things*, Apress, 2016.
[11] Y. Mansourian, *Research Method in Information Science and Epistemology*, SAMT, Humanities Research and Development Center, 2019.
[12] J. W. Creswell, P. Clark, A. Kiamanesh and J. Sarai, *Mixed Research Methods*, Aeeizh Publications, 2019.
[13] H. Khanifar and N. Zarvandi, *Qualitative Research: A New Approach in Management Studies*, Rahbord Publications, (2010) 243–256.
[14] R. A. Nourouzi and M. Bidhendi, *Human agency in qualitative approach to research*, Rahbord J. 54–187.
[15] R., Shamsuddin, *Modeling the income model of Iranian football clubs: A grounded theory approach*, Appl. Res. Manag. (2017) 101–116.
[16] H. Khanifar, N. Moslemi and H. R. Yazdani, *Principles and foundations of qualitative research methods*, Negahe Danesh J. (2018).
[17] S. M. Alwani, M. Khanbashi and H. Boudlaie, *Explaining the concept of epoche in phenomenological research and its application in the field of entrepreneurship*, Rahbord J. (2014) 7–21.
[18] B. Shabani Varaki and S. Kazemi, *Qualitative research: some methodological considerations*, Strat. Res. Inst. (2009) 33–58.
[19] H. Rohani, *Fields and approaches of qualitative research*, Rahbord J. (2010) 7–29.
[20] Gh. Khaki, *Research method (with Thesis Approach)*, Fouzhan, 2016.
[21] A. Chalmers and S. Zibakalam, *What is this thing called Science?: An Introduction to the Philosophy of Science*, SAMT, 2004.
[22] L. Newman, A.H. Faqihi and B. Honey, *Social Research Methods: Qualitative and Quantitative Approaches*, Termeh Publication, Iranian Association of Management Sciences, 2018.
[23] Z. Sarmad, A. Bazargan Harandi and E. Hejazi, *Research Methods in Behavioral Sciences*, Agah Publications, 2004.
[24] J. Dazizeh and M. Rezaei, *How Robots Make It Hard to Work?*, Newspaper No.: 4895, Publication Date: May 23rd, 2020. News No.: 3656700, source: https://www.theverge.com.
[25] S. Klaus and M. Shani (Translator), *Fourth Industrial Revolution*, Commercial Print and Publications Company, 2016.
[26] H. Moftakhari, *Book of the Month History and Geography*, 146 (2010). http://www.oral-history.ir.
[27] A. Vaezi and F. Fazeli, *Dialogue, dialectics, mixing horizons*, Shenakht J. 189.62 (2010).
[28] I. Berlin, *Hedgehog and Fox Book quoted by the Article of Freedom and Political Philosophy in the Thought of Isaiah Berlin*, Heybatullah Baghi, Donya-e-Eqtesad Newspaper, (1953).
[29] M. Nilssen, *To the smart city and beyond? Developing a typology of smart urban innovation*, Tech. Forec. Social Change, 142 (2019) 98–104.
[30] H. Yu, H. Qi and K. Li, *CPSS: A study of cyber physical system as a software-defined service*, Procedia Comp. Sci. 147 (2019) 528–532.
[31] B. Nakhuva and T. Champaneria, *Study of various Internet of things platforms*, Int. J. Comp. Sci. Engin. Sur. 6(6) (2015) 61–74.
[32] G. G. Parker, M. W. Van Alstyne and S. P. Choudary, *Platform revolution: How Networked Markets are Transforming the Economy and How to Make Them Work for You.* WW Norton & Company, 2016.
[33] N. Carvalho, O. Chaim, E. Cazarini and M. Gerolamo, *Manufacturing in the fourth industrial revolution: A positive prospect in sustainable manufacturing*, Procedia Manufac. 21 (2018) 671–678.
[34] D. S. Evans and R. Schmalensee, *Matchmakers: The New Economics of Multisided Platforms*, Harvard Business Review Press, 2016.
[35] A. Kantrowitz, *That Oreo Tweet Was Cool, But is Real Time Marketing Worth the Hype?*, (2013). https://www.forbes.com
[36] E. Ismagilova, L. Hughes, Y. K. Dwivedi and K. R. Raman, *Smart cities: Advances in research-An information systems perspective*, Int. J. Info. Manag. 47 (2019) 88–100.
[37] http:// www.datapine.com/blog/advanced-manufacturing-analytics.
[38] C. Lim, K. J. Kim and P. P. Maglio, *Smart cities with big data: Reference models, challenges, and considerations*, Cities 82 (2018) 86–99.
[39] T. Thiru, *Three Key Elements of A Successful Smart City Forbes Technology Council*, 2019.
[40] B. Nguyen and L. Simkin, *The Internet of Things (IoT) and marketing: the state of play, future trends and the implications for marketing*, (2017) 1–6.

[41] J. R. Gil-Garcia, T. A. Pardo and T. Nam, *What makes a city smart? Identifying core components and proposing an integrative and comprehensive conceptualization*, Info. Polity, 20(1) (2015) 61–87.

[42] L. Mora and M. Deakin, *Untangling Smart Cities: From Utopian Dreams to Innovation Systems for a TechnologyEnabled Urban Sustainability*, Elsevier, 2019.

[43] J. Dzieza, *How hard will the robots make us work?*, Translated by Rezaei Maryam, Donyaye Eghtesad Newpaper, 2020.

[44] M. Chiranjeevi, *Business Strategy Series*, 2017. https://digitalready.co/blog

[45] R. Jonash, H. Koehler and I. Onassis, *The power of platforms*, Business Strategy Series, 2007.

[46] A. Ghazawneh, *The role of platforms and platform thinking in open innovation networks*, J¨önk¨öping Int. Business School Proc.43rd Hawaii Int. Conf. System Sci. 2010.

[47] S. Lemine, M. Rajahonk, M. Westerlund and R. Siuruainen, *Ecosystem business models for the Internet of things*, Internet of Things Finland, 1 (2015) 10–13.

[48] W. Sarni, C. Stinson, A. Mung, B. Garcia, S. Bryan and J. Swanborough, *Harnessing the fourth industrial revolution for water*, World Economic Forum, 2018.

[49] *The World Economic Forum in Collaboration with The Boston Consulting Group,* Reshaping Urban Mobility with Autonomous Vehicles Lessons from the City of Boston, (2018).

[50] *World Economic Forum, The future of jobs report 2018*, Geneva: World Economic Forum, 2018.

[51] B. Nakhuva and T. Champaneria, *Study of various Internet of things platforms*, Int. J. Comp. Sci. Engin. Sur. 6(6) (2015) 61–74.

[52] P. P. Ray, *A survey of IoT cloud platforms*, Future Comp. Info. J. 1(1-2) (2017) 35–46.

[53] Z. N. Mndebele and M. Ramachandran, *IoT based Proximity Marketing*, IoTBDS, 2017.

[54] S. Tanwar, S. Tyagi and S. Kumar, *The role of Internet of things and smart grid for the development of a smart city*, Intelligent Communication and Computational Technologies. Springer, Singapore, 2018. 23-33.

[55] N. Carvalho, O. Chaima, E. Cazarinia and M. Gerolamo, *Manufacturing in the fourth industrial revolution: A positive prospect in sustainable manufacturing*, Procedia Manufac. 21 (2018) 671–678.

[56] S. Rajput and S.P. Singh, *Identifying industry 4.0 IoT enablers by integrated PCA-ISM-DEMATEL approach*, Management Decision, 57(8) (2018) 1784–1817.

[57] *Sangeet Paul Choudary*, Book of Platform Scale, 2015.