

Challenges in Applying IR4.0 Technologies to Improve Organizational Structure and Positions: The Case of Malaysian Public Agencies

(Cabaran dalam Mengaplikasikan Teknologi Revolusi Perindustrian Keempat bagi Menambah Baik Struktur Organisasi dan Perjawatan: Kajian terhadap Agensi Awam di Malaysia)

Syafini Samsudin
Mohd Hizam Hanafiah
(Faculty of Economics and Management, Universiti Kebangsaan Malaysia)

ABSTRACT

Despite the challenges, the Fourth Industrial Revolution (IR4.0) offers prospects for enhancing public service delivery. This article identifies the challenges in applying IR4.0 technologies to improve organisational structure and roles of Malaysian public agencies. The Socio-technical Systems Theory, Learning Organization Theory, and Theory of Disruption are discussed as a theoretical framework of this article. Employing the qualitative grounded theory methodology, data was collected from 26 public officials through interviews and a focus group discussion. The results reveal seven themes categorised into internal and external challenges. The internal challenges include human resources, financial resources, work process, digital data, laws and regulations, and the agency's function, while public perception forms the sole external challenge. Seven research propositions have been developed to propose the relationship between these challenges and the implementation of IR4.0 technologies in improving organizational structure and positions. The research provides empirical evidence on the challenges facing public agencies in using IR4.0 technologies to improve organizational structure and positions, thus offering recommendations that public officials must reformulate and restructure their approach in managing human resources during IR4.0.

Keywords: IR4.0; Industry 4.0; organizational structure and positions; public agency; Malaysia

ABSTRAK

Walaupun terdapat pelbagai cabaran, Revolusi Perindustrian Keempat (IR4.0) hadir dengan potensi penambahbaikan penyampaian perkhidmatan sektor awam. Artikel ini mengenalpasti cabaran dalam mengaplikasikan teknologi IR4.0 untuk menambah baik struktur organisasi dan perjawatan agensi awam di Malaysia. Kerangka teoretikal kajian ini berasaskan Teori Sistem Sosio-teknikal, Teori Pembelajaran Organisasi dan Teori Gangguan. Kajian ini menggunakan metodologi kualitatif "Grounded Theory" dengan pengumpulan data melalui kaedah temu bual dan perbincangan kumpulan fokus kepada informan yang terdiri daripada pegawai perkhidmatan awam. Penemuan kajian menunjukkan terdapat tujuh tema yang boleh dibahagikan kepada dua kategori iaitu kategori cabaran dalaman dan kategori cabaran luaran. Terdapat enam tema dalam cabaran dalaman iaitu sumber manusia, sumber kewangan, proses kerja, data digital, undang-undang dan peraturan, serta fungsi agensi, manakala persepsi awam merupakan tema bagi cabaran luaran. Tujuh proposisi kajian telah dicadangkan untuk menerangkan hubungan di antara cabaran dan penggunaan teknologi IR4.0 bagi menambah baik struktur organisasi serta perjawatan agensi awam. Kajian ini memberikan bukti empirikal kepada cabaran yang dihadapi oleh agensi awam dalam menggunakan teknologi IR4.0 bagi penambahbaikan struktur dan perjawatan, serta memberikan cadangan kepada kerajaan dalam menguruskan sumber manusia di era IR4.0.

Kata kunci: IR4.0; Industri 4.0; struktur organisasi dan perjawatan; agensi awam; Malaysia

INTRODUCTION

The Malaysian Government has allocated 27.5 percent of its RM307.5 billion budget for 2021 to the emoluments of public officials and another 8.8 percent to pensioners (Kementerian Kewangan Malaysia 2020). The allocation is rising annually since it is calculated based on the total number of public servants, annual increments, and retirement payments. To regulate the cost the government has since capped the number of public positions to 1.71 million, limiting new positions to replacement or redeployment of current staff. The same policy applies to all restructuring proposals within public agencies (Kementerian Kewangan Malaysia 2021).

However, with burgeoning population and the need to provide more services, public agencies are requesting additional positions, thus inducing the government to consider the possibility of using IR4.0 technologies to resolve the issue. Studies have shown that these technologies increase revenue and decrease the need for human workforce in various areas (Anshari 2020; Braccini & Margherita 2018; Herrero et al. 2020; Kagermann et al. 2013), prompting governments worldwide to explore integrating IR4.0 technological approaches into policy planning (Yang & Gu 2021). The Malaysian Government announced the implementation of the Public Sector Big Data (DRSA) pilot project in 2013 (Hamzah et al. 2020) and three critical national policies based on IR4.0 technologies; namely the National Digital Economy Blueprint, the National Fourth Industrial Revolution Policy, and the 12th Malaysia Plan (Unit Perancang Ekonomi 2021). These policies collectively highlight the role of IR4.0 technologies in public services.

While most studies discuss the use of IR4.0 technologies to determine organizational structure and positions, the focus has mainly been limited to the business sector or private entities (Przytuła et al. 2020; Sinha & Roy 2020; Zemtsov 2020), leaving a gap in research on the public sector. The objective of business entities differ from those of public entities since the aim of increasing revenue and eliminating cost may not directly apply to public agencies. Gajdzik, Grabowska and Saniuk (2021) emphasize that the use of IR4.0 technologies is uniquely determined by the specific needs of the industry and the organization, suggesting that their adoption in public agencies will depend upon the requirements of the public sector. Hence, this study focuses on one aspect of the issue; namely, in identifying the challenges of using IR4.0 technologies in the public sector. This study will contribute to the literature on IR4.0 and public service, through elucidating the unique challenges in applying these technologies to specifically improve organizational structure and positions in public agencies. The study therefore seeks to answer the research question: *What are the challenges in applying IR4.0 technologies to improve organizational structure and positions of Malaysian public agencies?*

LITERATURE REVIEW

THE INDUSTRIAL REVOLUTION

The world has witnessed four industrial revolutions. The First Industrial Revolution started in England during the mid-18 century with the invention of steam engine, substituting the use of manpower for machines (Pereira & Romero 2017). Almost 100 years later, the Second Industrial Revolution began with the introduction of electricity, thus flourishing mass manufacturing (Jain & Ajmera 2021). The invention of microchip at the end of the 20th century marked the Third Industrial Revolution, changing technologies from analog to digital, introducing personal computers, the Internet, handphones, and automation (Rymarczyk 2020). The Fourth Industrial Revolution (IR4.0), also known as Industry 4.0, was introduced in German in 2011 as an initiative by the government to develop the industrial sector. The initiatives then became revolutionized, mainly because the technologies blurred the line between the physical, digital, and biological worlds (Poszytek 2021).

Among the critical features of IR4.0 technologies are digitalization, optimization, human-machine interaction, automatic data exchange, and communication advancement (Roblek et al. 2016). These features serve as elements for nine pillar technologies of IR4.0: big data analytics, autonomous robots, simulation, system integration, the Internet of Things (IoT), cyber security, cloud computing, additive manufacturing or 3D printing, and augmented reality (Rüßmann et al. 2015; Yang & Gu 2021). These technologies have developed into other technologies with numerous applications, such as artificial intelligence, autonomous car, and blockchain (Rymarczyk 2020; Silva et al. 2019).

Similar to the effect of other industrial revolutions, IR4.0 transformed how jobs are done, bringing changes in job design, job environment, and structure (Herrero et al. 2020; Kagermann et al. 2013). Its technologies are disruptive because they change all production aspects, from product design to marketing to after-sales services (Miśkiewicz & Wolniak 2020). Such changes divide the work structure into two continuums, one of the high-skill workers in an organic structure and another with low-skill workers easily replaced by machines (Wilkesmann & Wilkesmann 2018).

CHALLENGES IN APPLYING IR4.0 TECHNOLOGIES

The discussion on challenges in applying IR4.0 technologies in organizations can be categorized into two categories; internal and external. Internal organizational challenges are led by human-related elements such as lack of skills, competencies, and development team (Ellitan 2020; Szabo et al. 2020). Financial resources are a common theme mainly because installing IR4.0 technologies is costly, and the organization must invest in infrastructure to provide better Internet coverage (Gajdzik et al. 2021; Gavrić & Mlakić 2019). As for management-related elements, the discussion revolves around the lack of managers with appropriate competencies and the ability to lead in changing environment, the lack of understanding of the most appropriate technologies for the organization, and inadequate organizational structure that hinders the technological advancement process

(Ellitan 2020; Szabo et al. 2020). Another challenge for management is data management which begins from data acquisition, storage, mining, and cleaning to data analysis, modeling and data interpretation (Dikhanbayeva et al. 2021; Hamzah et al. 2020). Challenges are also discussed in terms of the work process, work organization, and working conditions (Haipeter 2020; Kagermann et al. 2013) which also related to social aspects of adaptation to IR4.0 technologies.

External challenges are preceded by limited access to the Internet or poor information communication technology (Dikhanbayeva et al. 2021; Lele & Goswami 2017), cyber security and cyber-attacks (Rymarczyk 2020), and maturity of technologies, including the lack of standards as well as communication protocols (Hamzah et al. 2020; Szabo et al. 2020). External challenges can also come from the lack of government support, causing disharmony between the education system and the labour market (Dikhanbayeva et al. 2021; Gavrić & Mlakić 2019). In addition, external challenges also relate to privacy violations (Rymarczyk 2020) and the rise of threats to individual autonomy (Soh & Connolly 2020) by entities utilizing IR4.0 technologies.

ORGANIZATIONS AND THE ROLE OF HUMAN RESOURCE PRACTITIONERS

An organization is formed to execute a function or achieve a goal, and the structure is designed to ensure that the objective is attainable. Mintzberg (1979) proposes the Five Organizational Structure Model of organization, based on five main components: the Operating Core, Middle Line, Strategic Apex, Support Staff, and Technostructure. From the components, five structures of organizations are developed: simple structure, machine bureaucracy, professional bureaucracy, divisionalised form, and adhocracy, with each structure being dominant in one component depending on the nature of business, the time, and the environment (Lunenburg 2012).

In explaining the organization's design, Galbraith (2002) suggests the Star Model with five dependable dimensions: strategy, people, structure, reward, and process, with strategy taking the lead by determining the direction of an organization. Concerning organizational structure and positions, Cimini et al. (2021) refer to Galbraith's structure as having two primary constructs: number of hierarchy (Pugh et al. 1968) and span of control (Ouchi & Dowling 1974), while process refers to the design of positions within an organization and relates to the roles of individual position. Structural and positional change in an organization is influenced by external factors such as globalization, technology, economic environment, customer, and competition, as well as internal factors such as development strategy, type of activity, inefficient current structure, and qualifications of its members (Kalowski 2015).

Organizing structural changes, redesigning job descriptions, reviewing individual roles, and identifying the number of positions needed lie with human resource practitioners, especially during IR4.0, because of the socio-technical elements associated with adapting new technologies (Sony & Naik 2019). Human resources practitioners must strategize implementing change management (Lord 2020) due to the possibility of reducing the current workforce (Ziaei Nafchi & Mohelská 2021). Apart from providing new skills training (Kiss & Muha 2018), human resource practitioners must be able to think strategically and act as change agents (Dhanpat et al. 2020; Poban-Nzaou et al. 2020; Yusuf et al. 2017) to maintain their relevance in the structure since routine HR tasks are to be automated using IR4.0 technologies (Drljača et al. 2020).

In Malaysian public services, the task of evaluating restructuring proposals of organizations lies with a central agency at the federal level, whose functions include developing human resources policies for public agencies. Although human resource practitioners are empowered to manage within their respective agencies and have the freedom to plan for their structure and positions, the implementation is subject to approval from the federal level due to financial implications sustained by the government as a result of that process (Bahagian Pembangunan Organisasi JPA 2020).

THEORIES ON IR4.0, ORGANIZATIONAL STRUCTURE AND POSITIONS

Three theories serve as a theoretical framework for this study. The first is Socio-technical Systems Theory (STS), which posits that an organization is a combination of social and technical components, interacting with its environment (Trist et al. 1993). According to the theory, the social element of people and their relationships, and technical element of digital applications, equipment, and processes, must work cohesively to achieve the organisational objective (Appelbaum 1997). Cimini et al. (2021), through an expansion on the STS approach, suggest that a lean organizational structure supports effective adoption of Industry 4.0 technologies which should not dictate the restructuring of the organization but rather leverage them to enhance adaptability to the new processes through comprehensive training. This study relates to STS by examining socio-technical elements in public agencies and assessing how these elements improve organizational structure and positions.

Learning Organisation Theory (LOT) proposes that, to stay competitive and achieve goals in a changing environment, organizations must learn to adapt by making conscious choices as a response to the environment (Senge 1996). Senge's learning organization comprises five disciplines; system thinking, personal mastery, mental models, shared vision, and team learning, which are essential if the organizations are to learn and adapt (Fillion

et al. 2014). Learning organizations nurture continuous transformation, resulting in greater innovation and adaptability to changing environments, thus moving beyond rudimentary employee training into organizational problem solving (Dawood et al. 2015). Since IR4.0 technologies are constantly developing, this theory emphasizes the importance of continuous learning and constant reskilling to survive (Belinski et al. 2020; Piątkowski 2020) and ultimately influencing organizational structure through changing work processes and job design.

The third theory relevant to this study is the Theory of Disruption, which posits that technological advancement is causing disruptive changes across the world (Christensen & Raynor 2003). IR4.0 technologies are inherently disruptive, changing almost everything related to how businesses are run (Herrero et al. 2020; Kagermann et al. 2013; Miśkiewicz & Wolniak 2020). Their ongoing evolution lead to further disruption of older technologies (Yang & Gu 2021). Since the study is about the impact of IR4.0 technologies and their disruptive impact on organizational structure and positions, the Theory of Disruption is quite appropriate for explaining the phenomenon.

METHODOLOGY

The study was exploratory and conducted using a qualitative approach. It aimed to identify the challenges in applying IR4.0 technologies to enhance the organizational structure and positions in Malaysian public agencies. Given the scarcity of research in the public sector addressing the issue of organizational structure and roles during IR4.0, this study adopted the grounded theory research design by Glasser and Strauss (1967) and the Constructivist Grounded Theory approach (Charmaz 2006). Grounded theory was deemed the most appropriate design for this study since discussion on public agencies' organizational structure and IR4.0 represented a novel phenomenon. To understand this phenomenon, theories served as a guide (Creswell & Poth 2018) in interpreting the relationship between humans, organizations, and technologies. These theories were essential in maintaining focus when engaging with rich data sources from the interviews and assisted during the initial stage of data analysis.

Data were collected through semi-structured interviews and a focus group discussion. A combination of convenience, purposive, and theoretical sampling strategies was employed to ensure that all informants could significantly contribute to the study (Bryman 2008; Miller & Salkind 2002). The selection of informants was based on the following criteria: (1) officers in Federal Ministry/Department, State Government, Local Government, or statutory body under government's control; (2) middle to top-level managers of Grade 48 to Grade JUSA C (the highest position of the public sector); (3) those occupying management positions or involved in human resources organizational development; (4) having at least two years of experience in organizational development.

Initially, two sessions of in-depth pilot interviews were conducted, and the questions were revised based on these interviews. The final interview guide comprised eight semi-structured questions, including introductory ones. A formal request was sent via email to 23 heads of agencies, but only 22 agreed to participate, with one agency declining due to managerial issues. Over four months, 11 sessions of semi-structured interviews were conducted with 16 participants, and a focus group discussion of 10 informants was organised. The profile of informants is shown in Table 1.

Of all the interview sessions, eight sessions were conducted face-to-face, while three interviews were conducted online. Face-to-face interviews were held in informants' offices across Malaysia lasting between fifty minutes to one hour and twenty minutes, with all 16 informants consenting to audio recording. Meanwhile, a focus group discussion was organised at a later in the data collection stage, focusing on informants located around Putrajaya (federal government administrative centre) and Kuala Lumpur, and served as a triangulation method to enhance the validity of the data. The initial date was postponed for two weeks due to COVID-19, and of all 11 informants who agreed to participate, one was unable to attend due to medical reasons. The discussion lasted three hours, and all informants consented to video recording. All questions during interviews and focus group discussion were in an open-ended manner, emailed in advance, and were the same for all informants. The recordings were transcribed verbatim for data analysis and coded using Strauss and Corbin's (1998) open, axis, and selective coding. *Atlas.ti* software facilitated data management and ensured all relevant data were coded. Data saturation was achieved during the interviews when no new code emerged (Glasser & Strauss 1967) and was confirmed during focus group discussion.

TABLE 1. Profile of informants (n = 26)

No.	Code	Job Function	Grade	Type of Agency	Sector of Agency
1	B1	HR	48	Statutory Body	Economy
2	B2	OD	52	Statutory Body	Agriculture
3	B3	Management	48	Statutory Body	Development authority
4	B4	Management	54	Statutory Body	Education
5	B5	HR	JUSA C	Statutory Body	Education
6	B6	HR	52	Statutory Body	Education

7	P1	Management	52	Local Government	City Council
8	P2	Management	54	Local Government	City Council
9	P3	Management	48	Local Government	City Council
10	N1	HR	54	State Government	Administration
11	N2	OD	52	State Government	Administration
12	N3	HR	54	State Government	Administration
13	N4	OD	52	State Government	Administration
14	N5	OD	48	State Government	Administration
15	N6	HR	54	State Government	Administration
16	K1	OD	52	Federal Ministry	Infrastructure
17	K2	OD	54	Federal Ministry	Education
18	K3	HR	54	Federal Ministry	Economy
19	K4	OD	52	Federal Ministry	Security
20	K5	OD	52	Federal Ministry	Health
21	K6	OD	52	Federal Ministry	Security
22	K7	OD	52	Federal Ministry	Security
23	J1	HR	54	Federal Department	Infrastructure
24	J2	HR	48	Federal Department	Infrastructure
25	J3	OD	48	Federal Department	Security
26	J4	HR	48	Federal Department	Administration

Note: HR, human resource; OD, organizational development.

By employing Constructivist Grounded Theory (Charmaz 2006), this study aims to co-create the reality of the informants, drawing on their perspectives as data by interpreting meanings in broader social structures. The meanings that emerge are then formulated into research propositions.

FINDINGS

Based on the analysis, seven themes were identified as challenges in applying IR4.0 technologies to improve the organizational structure and positions in Malaysian public agencies.

HUMAN RESOURCES

The study found that the primary challenge was related to human resources. This included an entrenched mindset regarding organisational structure and the number of positions needed to support that structure. It also referred to the failure to properly understand the difference between function and technologies, with many still viewing technology as mere tools to execute the function rather than to shape function itself. The study also revealed a tendency to maintain old norms and ratios in determining the number of required positions, and also to assume that branch offices should duplicate the organisational structure of the headquarters.

“When we introduce new technology, we inform them that it will take over their job. However, for them, the new technology is equivalent to a new function. Therefore, new positions are needed to administer and manage that technology” (Informant K4).

“Agency view enforcement activity as carrot and sticks. The current norm for determining positions is based on the number of factories the officers must visit once a year. The number of officers per visit is two. So, they developed a ratio based on the number of factories and the number of officers needed. Then they submit their restructuring proposal to the JPA (a central agency at the federal level in charge of restructuring) based on the ratio. So, when we did this, the ideal number of positions, it turns out that we need 200 to 300 positions (20% increase from the overall number of positions in that agency)” (Informant K1).

“So, when we set up this centre, we gave a new set of positions to run the centre, which act as a central agency, so the thinking is, the same new set of positions should exist in faculties as well, duplicating the positions in the central agency, but the workload is much lower” (Informant B5).

Challenges in human resources also emerged from differing expectations between the policy-making agencies and those responsible for execution, underlining the gap between the ideal and the practical. It was related to the shortfall in the competent workforce.

“The challenge is when the policy maker wants to automate everything, but at the implementation stage, things work differently; I am talking about the readiness - to prepare the workforce with competency and skills needed to execute the policy, they must be trained first” (Informant K2).

FINANCIAL RESOURCES

This study identified financial resources as the second challenge in applying IR4.0 technologies to enhance organizational structure and roles in Malaysian public agencies. The main concerns were the cost associated with acquiring the technologies and expenses related to training. In both cases, financial planning and annual budgeting became quite crucial beginning with identifying the right technology and bidding for the funding, to acquiring it through government procedures and allocating the budget for training.

“The challenge is finance because if we were to get the technology, the budget is high, we have to apply first, we try to bid the budget this year because we are using Operational Expenditure. This year, we have been given this amount of budget, we have to adjust our necessities, we operate within that budget, so, we may not be able to have everything we need” (Informant B1)

“Another challenge is the training budget, we want to arrange the training, the job function and all that, but it has to be in line with yearly budget, for procurement and for training, that comes hand in hand” (Informant K6).

Financial resources also reflect on the financial capability of agencies to implement digitalization. This study found that in smaller offices in some states and local authorities, the pace of digitalization was at a moderate rate, even before considering the adoption of IR4.0 technologies. The trend was particularly pronounced in the lower-income states, whereas digitalization was more developed in high-income states.

“For me, digital government is at its basic, people are talking about IR4.0, and even about 5.0, but we are still at infancy, our digitalization effort is not more than 50 percent” (Informant P2 - from the low-income state).

“But for the rest of us, I think for the last five years, have been drummed into them that we will always change, we will always lead, we will always be the pacemaker, we must be the beginner. So, by that virtue, public officers in this state had realized and always ready to use whatever new technologies, no problem” (Informant N6 - from the high-income state).

In addition, financial resources adversely affected the ability to provide a stable communication infrastructure for public agencies.

“Now we have 5G, but which areas actually get the 5G coverage? Even the 4G coverage is not available for all. This is what the Federal Government should work on. This problem should be dealt with earlier because with better coverage, there will be lesser problems” (Informant P1).

WORK PROCESS

The work processes were found to originate from functions that an agency must perform. Although strategies may change, the functions however generally remain the same. The main challenge in adopting IR4.0 technologies was the dependence on conventional work processes that do not evolve in response to environmental changes. Such approach may constraint efforts to improve organizational structures and positions.

“This is a work process. For example, at One Stop Centre (OSC), all applications for development plans must be submitted through OSC; it has guidelines with 22 checklists that every agency must adhere to. I am the chairman. The issue is I want to restructure the compliance timeline because, with all the assessments, approval will take four months at a minimum, but the businesses cannot wait, investors will turn to another country. So, I cut the time short by using the recent assessment conducted in the same area but for another application. As a result, one factory started exporting its product after the tenth month. But the issue on restructuring time has yet to be solved at the federal level” (Informant P2).

The informants recognised that the work processes influenced the organisational structure and the number of positions needed. Therefore, any changes to the work processes were bound to affect both the structure and staffing requirements.

“After the programming team settles, it goes to the layout and design team; if one team fails to settle, another team cannot start their work. Before this, all of the specialists are in one team, but the structure has changed into a production line in a factory. This indicates that the work process influenced the need for positions. We try to change that by reviewing flow charts and checklists because that is where the process becomes slow and inefficient” (Informant B5).

“Now we have to update Service Record Book manually and the HRMIS (a digital record for human resources’ matters), we have to update and doing the same thing twice, if we are to utilize IR4.0, then the manual record is not needed” (Informant K6).

DIGITAL DATA

Digitalization is fundamental to IR4.0 technologies (Gajdzik et al. 2021), making the scarcity of digital data a critical challenge in enhancing organizational structure and functions of public agencies. This study revealed that either the complete absence of digital data, or their insufficiency, coupled with varying levels of adaptation to digitalization, impacted the readiness of agencies to effectively utilize IR4.0 technology.

“Still, data is not an important element in public agencies; they have yet to appreciate that those physical files are stored in a way that cannot be digitally analysed; you cannot use the data even though you have rich data. The data cannot be used because it was not stored in a form that can be analysed. For me, this is the exercise that should be settled first. If you just update the data in the system, it’s not yet data analytics; it’s just digitalization. Public agencies must address the data collection issue; if not, we will not be able to move towards data analytics” (Informant P2).

“The number of positions can be reduced, but someone has to key in the base data, the base is what we need most. If you want to go to AI or neuro networks, you will need a huge amount of data, at least 20 thousand if I am not mistaken; if not, it doesn’t make sense” (Informant N6).

LAWS AND REGULATIONS

This study found that current laws and regulations in public services pose a challenge to the adaptation of IR4.0 technologies in improving organizational structure and positions. The adaptation process for these technologies is hindered by legal frameworks that don’t quite recognise digital data. In addition, existing laws and regulations are bound to be either too general or too limited (Hamzah et al. 2020) and may sometimes fail to address local issues fairly.

“In running the office, digitalization does make the job easier, but the hard copy is still the main source, still very much in need. The physical filing must be maintained because when auditors come for Star Rating (performance audit for public agencies), APPC (award for excellent office administration), inspection from police, and customs, they want the hard copy. The same goes for the court process; documentation must be in hard copy. When we serve the compound for unpaid assessment rates and other taxes, we have to serve manually because the law said so” (Informant P1).

“The problem with our regulations is it can resolve the problem at that time. The world has changed, but the regulations are not, and then we generalized the regulations to all local authorities. No, you cannot. Because every locality has its uniqueness, you have to understand the uniqueness of every locality; only then can we address as a local issue” (Informant P2).

The slow response to technological advances is a global phenomenon, often resulting in laws and regulations lagging behind technology (de Ruyter et al. 2019). Such delay may pose significant implications such as the possibility of AI replacing lawyers, especially in routine legal works such as contract analysis and case prediction (Gravett 2020).

THE AGENCY’S FUNCTION

Unlike private entities and businesses, public agencies' functions are determined by the government. This suggests that the decision to enlarge or cease operations does not depend on the agencies themselves. They do not choose their target group and must serve all citizens without prejudice thus making increased workloads and expanded functions challenging when applying IR4.0 technologies in order to improve organizational structures and positions.

“With the increasing number of people, business premises will increase, properties will increase, and we have to give them the service, the best services because they are paying the taxes” (Informant P1)

Due to the nature of services provided by public agencies, their comparison with business entities or manufacturing plants are not be straightforward. The structure of public agencies must reflect the degree of decision-making allowed, thus suggesting that the structure may largely remain the same even with the adaptation of IR4.0 technologies. Additionally, given the hierarchical nature of public agencies they may differ due to a variety of functions; namely as policy-making bodies, implementation units, enforcement divisions, and monitoring groups, with multiple levels from federal agencies to local authorities. IR4.0 technologies may decrease the number of positions in these entities but may not affect their overall structure.

“Government gives services, in service, the agency does not have to be flattened because we need a certain level of stakeholders, a certain level of clients, and we have a certain level of officers to take charge, so it does not have to be flattened - for example, the application of Bumiputera (the native people) status. The District Office receives the application, needs positions for data entry to key in the data, Residence Office needs higher-level officers to check and verify the data, and Bumiputera Court needs the highest level of all because the court is the decision-maker. It depends on the function of the agency” (Informant N3).

This study also revealed that public agencies, being the sole service provider, face challenges from competitors forcing them to strive harder in serving their customers.

“Now the businesses are approaching individual customers, and it’s a norm in businesses. They will call your handphone asking if you need a new shoe because you have bought it from their store. Why? Because they have to compete. But in government, we don’t have such initiatives. But the people will compare, I get this kind of service from the business, but I get this kind of service from public agencies? Why can’t the government provide the same service? You have all my data, my birth information, school registration data, income tax data, and soon my death data” (Informant P2).

PUBLIC PERCEPTION

This study also discovered that public perception has become a challenge in applying IR4.0 technologies to improve public agencies' organizational structure and positions. The perception that greater visibility of security officials guarantee a safer environment and that public agencies should serve the people well may erroneously lead to a public mindset that necessitates and prioritise for more positions instead of reducing them.

“In the police force, the effectiveness of enforcement depends on the public perception that the police are among the public; the public wants to see the presence of police. For that reason, the agency has been applying for more positions every year, because the number of citizens is rising steadily, and cities are growing bigger” (Informant K4)

“We cannot move further until we are all educated, until there is a change in mindset. I am talking about mindset; we are still far behind. I am hoping for our children’s generation - for example, garbage collection service. If the people are well-disciplined, they manage their garbage well; there will be no dropping when people bring their trashes out, then there is not much to be enforced, we don’t need so many H11 (labourers) anymore” (Informant P3).

However, since public perception relates to culture, implementing IR4.0 technologies at the societal level must consider the cultural variations across multiple societies and countries (Dikhanbayeva et al. 2021).

DISCUSSIONS AND PROPOSITIONS

The findings indicated that six emerging themes were internal challenges within the public service, with only one external challenge, suggesting that most challenges could be surmounted. The first theme was human resources. The study showed that for public agencies to benefit from IR4.0 technologies, they need to change their mindset, leave their comfort zone, and embrace technological transformation. Considering the disruptive nature of these technologies, public officials must anticipate the potential changes and manage them to benefit public services. In consequent, the research proposition (RP) was:

RP₁ The higher the readiness of human resources to change, the lower the challenge in applying IR4.0 technologies to improve organizational structure and positions of public agencies.

The second theme addressed financial resources. The government financial plan requires public agencies to plan years in advance for the financial year, and ensure that all aspects are covered. Consequently, the authors proposed the following research proposition:

RP₂ The more comprehensive the financial resources plan, the lower the challenge in applying IR4.0 technologies to improve organizational structure and positions of public agencies.

The third theme focused on the work process, inspiring public agencies to rethink their way of doing things and strategically benefit from IR4.0 technologies by eliminating unnecessary duplicative procedures within and between agencies, by removing insignificant processes that have no added value to service delivery. This was made possible with IR4.0 technologies, which lead to the following research proposition:

RP₃ The higher the willingness to review the current work process, the lower the challenge in applying IR4.0 technologies to improve public agencies' organizational structure and positions.

The fourth theme proved that the digitalization process was crucial for public agencies. The endeavour to digitalize 80 percent of public services in 2022 (Unit Perancang Ekonomi 2021) will significantly increase the amount of digital data in public agencies, while strategies must be devised to convert manual data into digital form. Therefore, the research proposition was:

RP₄ The higher the amount of digital data in public agencies, the lower the challenge in applying IR4.0 technologies to improve organizational structure and positions.

The fifth theme of laws and regulations distinguished public agencies from private entities and businesses. Adhering to the principle of separation of power, public agencies are governed by laws and regulations established by central agencies and audited by another. Quite often, these practices lag behind technological advancement utilized by the audited agency. At the same time, the varying levels of technological adaptation between agencies make it difficult to review the current laws and regulations. Therefore, the authors proposed the following research proposition:

RP₅ The higher the willingness to review laws and regulations, the lower the challenge in applying IR4.0 technologies to improve organizational structure and positions.

The agency's function emerged as another theme exclusive to public agencies. Lacking the authority to decide on its function and the kind of target group it should serve, public agencies performed their functions according to the laws, the services offered, the needs of the people, the level of agencies, and the local issues. The structure may not change significantly, unlike the number of assumed roles. Accordingly, the research proposition was:

RP₆ The function of a public agency relates positively to the application of IR4.0 technologies in improving organizational structure and positions.

Lastly, public perception presented another challenge in applying IR4.0 technologies. Since perception can evolve, public agencies must collaborate effectively to enhance to public perception and nurture a better community that can appreciate IR4.0 technologies and be ready to share the responsibility of maintaining a civilized nation. For that reason, the research proposition was:

RP₇ The higher the public perception towards the application of IR4.0 technologies in public services, the higher the possibility of improving organizational structure and positions.

THEORETICAL IMPLICATION

This study has made a significant contribution to the theory, particularly the Socio-technical Systems Theory by highlighting the importance of social aspects of public agencies, without which technology will be irrelevant. Social elements in this study were identified as the people and their relationships within the organization as well as those outside the organization who benefit from public service delivery. This study further extended this theory by proposing the social element outside the organization is linked to the relationship between organizations of different clusters, such as financier institutions, audit institutions, and legislative institutions, offering explanations on how technology influences these relationship. With regard to Learning Organisation Theory (LOT), this study suggested that non-profit organizations, such as public agencies, require continuous learning,

not because of competition but due to failure to engage in continuous learning which could lead to a lower standard of service delivery. This study also stressed the necessity of synchronising the degree of learning in public agencies to prevent gaps in public service delivery. Furthermore, this study also strengthened the idea of Disruption Theory by showing that technology advancement is particularly disruptive in public services, affecting not only public agencies per se but also policy development and implementation within a country. In terms of academic impact, this study proposed several hypotheses suitable for public agencies that could be verified in future studies.

MANAGERIAL IMPLICATION

As for the implication to the government, this study revealed that most challenges in implementing IR4.0 technologies in Malaysian public agencies are characteristically internal. Therefore, these challenges can be managed internally within specific agencies or between multiple public agencies. Through addressing these internal issues, public agencies can optimize the organisational structure and positions more effectively. The optimisation may result in a ripple effect, enabling public agencies to undertake multiple roles but with minimal workforce, thus effecting greater efficiency in budget allocation, including the emolument of public officials, enhancing return on investment, and enabling more positions to be distributed to sectors that necessitate human interventions. This study establishes that the current policies for restructuring and managing positions are sufficient in controlling the number of public officials, provided that technology is utilised efficiently.

Although the study has respondents from all levels of public agencies, they nevertheless did not comprehensively represent all public sector areas, resulting in some parts being underrepresented. Therefore, future studies should focus on these gap areas of the public agencies. In addition, future studies should also explore the public sectors in other countries since they may contribute greater insights, thus enriching our understanding of this phenomenon.

CONCLUSION

IR4.0 technologies offer great potential for improvising the Malaysian public sector. However, these technologies encountered several challenges which this study aspires to identify. The finding identified seven themes that emerged as challenges in applying IR4.0 technologies to improve organizational structure and positions in Malaysian public agencies. Six of these themes were internal such as human resources, financial resources, work processes, digital data, law and regulations as well as the agency's function. The study posits that internal adjustments can lower the challenges in applying IR4.0 technologies to improve structures of public agencies. In addition, public perception was identified as the only external challenge that could positively impact the possibility of improving organizational structure and positions. The application of IR4.0 technologies offers opportunities for improvement in public agencies in terms of their efficiency through performing more functions with fewer workforce, optimizing public fund and increasing return on investment, while serving growing population and managing their demands. This study aimed to identify the challenges faced in implementing IR4.0 technologies to improve organizational structures and positions in Malaysian public agencies. It discovered that deeply engrained mindset of human resource was the main challenge and constraint, and the readiness to change will reduce these trials. This study in particular emphasises the Socio-technical Systems Theory by highlighting the importance of human aspect and their mindset, without which technology will become irrelevant. For public agencies to improve their organizational structures and positions they must address internal challenges among the officials, ahead of introducing new technologies. One limitation of the study was its incomplete representation of all areas within the public sector, leaving out some regions from its coverage. Future studies should therefore focus on these areas as well as apply different research approaches.

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Syafini Samsudin (corresponding author)
Faculty of Economics and Management
Universiti Kebangsaan Malaysia
43600 UKM Bangi, Selangor, MALAYSIA.
E-Mail: syafinisamsudin@gmail.com

Mohd Hizam Hanafiah
Faculty of Economics and Management Universiti
Kebangsaan Malaysia
43600 UKM Bangi, Selangor, MALAYSIA.
E-Mail: mhhh@ukm.edu.my