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ARTICLE

A Fuzzy Delphi analytic job demands-resources model to rank factors influencing open innovation

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ABSTRACT

This study aims to determine the impact of the job demands-resources model and professional identity on open innovation in the industrial sector by adopting technology as a mediating variable. The factors that influence open innovation were identified based on the Fuzzy Delphi method. Hence, the quantitative (questionnaire survey) design was used to gather 260 employees in the industrial sector. The structural equation model (PLS-SEM) was used to analyse the data. The findings of this study reveal the positive impact of professional identity and feedback on open innovation and the negative impact of time pressure, workload, and work-family imbalance on open innovation. The results highlight vital internal and external factors in creating an organisational climate that encourages open innovation.

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Job demands-resources model; professional identity; open innovation; technology; Fuzzy Delphi

Introduction

In technological advancements, innovation is key to sustainable organisational success (Bass & Riggio, 2006). The organisations are striving to open innovation by relying on resources for long-term success. Open innovation is achieved through effective and efficient human-technology interaction. Open innovation dependent on human capital for producing new ideas to create innovation (Judge & Bono, 2000).

Hence, the organisations that have efficient use of technology quickly adopt organisational learning, excellent performance, increased productivity, higher profits, and market sustainability. Therefore, intellectual capital is a critical factor for organisational competitiveness (Darawad, Nawafleh, Maharmeh, Hamdan-Mansour, & Azzeghaiby, 2015). Besides, it is mandatory to enhance an organisation's value (Humphrey, Ashforth, & Diefendorff, 2015; Abdulaali et al., 2019).

In this context, the initial stages of innovation need informal communication networks. However, many organisations have faced several challenges in designing organisational innovation (Pauget & Wald, 2018). Individuals are more productive and innovative when they optimum utilisation their abilities and skills through the work-life balance and motivation (Alnoor, 2020; Darawad et al., 2015). The use of technology might help industries to increase productivity and enhancing organisational performance. However, it relies on the circumstances and resources that can help individuals achieve the required level of intellectuality to adopt new technology to create novel ideas. In addition, the organisations should help the employees to access for different training programs to improve their efficiency and effectiveness for exploitation innovation and achieve strategic goals (Abdullah, Ismail, Alnoor, & Yaqoub, 2021; Schaufeli & Taris, 2014). Besides, the organisation should provide support to help the employees optimum utilisation of available resources and pursue personal objectives and organisational goals (Al-Abrrow, Abdullah, & Atshan, 2019). Organisations can develop employees' professional identity by providing sufficient resources and aligning with individuals' preferences and professional requirements (Humphrey et al., 2015). Therefore, this study has been conducted to analyse job demand resources and professional identity on open innovation through the mediating role of technology intention.

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Moreover, the first section will discuss the previous literature. The second section illustrates developing hypotheses for the theoretical model of this study would be reviewed. Subsequently, the next section will explain this study's methodology by describing the study's sample size and measurement of variables adopted in this study. Finally, this study will analyse the data collection based on Fuzzy Delphi and PLS-SEM methods to figure out the results and suggest theoretical and practical implications.

Theoretical background and development of hypotheses

This section will discuss the concept of open innovation and the Job Demands-Resources (JD-R) model. Hence, the sub-concepts of the (JD-R) model will be linked with the use of technology and open innovation based on the previous literature.

Open innovation

In today's world, innovation to shifted from closed innovation to open innovation. Therefore, several companies rely on novel ideas in creating, developing, and financing, marketing. Moreover, companies try to employ the most intelligent human resource to develop innovative products and services (Chesbrough, 2003b). According to Chesbrough, Vanhaverbeke, and West (2006), the closed innovation led to inefficiency. However, closed innovation indicates validity in some industries or markets (Eneizan, Mohammed, Alnoor, Alabboodi, & Enaizan, 2019). On the other hand, open innovation refers to organisational reliance on internal and external knowledge (Hadi, Alnoor, & Abdullah, 2018; Pauget & Wald, 2018). The concept of open innovation emerged from reflections on the vital of external innovation. Therefore, the research and development department should focus on internal and external knowledge (Chesbrough et al., 2006; Hamid et al., 2021).

Open innovation involves two central, vital realities. Firstly, the customers have become the essential tool for innovation. Therefore, open innovation depends on extracting explicit knowledge of customers. Secondly, the innovations that have better succeeded in recent years have been obtained from outside the borders of organisations. Hence, open innovation attention on internal and external expertise (Chesbrough, 2003b). Open innovation is a model that assumes companies use external and internal ideas along with various other measures (Chesbrough, 2003b).

Consequently, open innovation does not focus solely on companies but includes creative consumers and creative communities of users (Gassmann, Enkel, & Chesbrough, 2010; Hadi, Alnoor, Ismail, Eneizan, & Makhamreh, 2019). The boundaries between the company and its environment become more effective. Thus, innovations can quickly move inward and outward amongst companies, creative consumers, industry, and society. Various reasons have contributed to the growth of open innovation because the information for open innovation is extensively disseminated across the economy (Bogers, Chesbrough, & Moedas, 2018). Although external innovation sourcing is not new, the current open innovation approach differs from past ones. In nearly every company today, the most exemplary ideas and individuals can be found elsewhere because of the globalisation of business and advancements in education and technological catch-up (Bogers, Chesbrough, Heaton, & Teece, 2019). Businesses may now rapidly connect to vast and worldwide technological communities, resulting in more effective problem-solving methods. Work activities are becoming increasingly digitally linked, and new patterns of cross-functional collaboration are emerging. Access to the domain and technical knowledge always is vital to a company's overall competitiveness (Choi, Kim, & Jung, 2019; Kumar, Goyal, & Mitra, 2019; Selmier, 2018).

Job Demands-Resources (JD-R) model

Every job has demand and requires specific resources. Job demand refers to physical, psychological, social, and organisational aspects of the job that require efforts and skills to perform the job. Therefore, associated with physiological and psychological costs (e.g. time pressure, work-family imbalance, and workload). Job resources refer to aspects available in a job. When a job requires more than the available resources, the human resources feel more pressure and vice versa (such as autonomy and feedback) (Demerouti, Bakker, Nachreiner, & Schaufeli, 2001). Studies indicate the positive impact of job resources (i.e. feedback and autonomy in performing the job) on employees' well-being and attitudes (e.g. Demerouti et al., 2001; Salanova, Agut, & Peiró, 2005). Hence, the

previous studies highlighted a negative impact of resources (i.e. time pressure, workload) on employees' attitudes (e.g. Bakker & Demerouti, 2007; Halbesleben & Buckley, 2004). Accordingly, the job outcomes depend on the nature of the job, employee characteristics, surrounding circumstances, and other organisational factors (Demerouti et al., 2001; Llorens, Bakker, Schaufeli, & Salanova, 2006). For example, a favourable outcome is achieved when job pressure contributes to the professional development and development of the employee by increasing the positive response to job pressure and finding creative ways to perform a job. On the other hand, when a job demands more physical and psychological efforts that exceed the employee's physical and psychological capabilities, this turns into a negative outcome and may cause to reduce the performance of staff (Bakker & Demerouti, 2007).

Previous studies indicate various dimensions regarding the JD-R model. For example, qualitative job demands, Emotional demands, Feedback, Mental demands, Physical demands, Work-home conflict, Quantitative demands, Professional Identity, Work overload, Work underload, Pace of Change, Organisational demands, Organisational change, Red tape, Harassment, Role conflict, Workload, Interpersonal conflict, Social resources, Social support, co-workers, Social support, Work-Family Imbalance, supervisor, Team atmosphere, Team effectiveness, Role clarity, Fulfilment of expectations, Recognition, Job control, Person-job fit, Task variety, Participation in decision making, Use of skills, Availability of tools, Autonomy, Communication, Alignment, Trust in leadership, Organisational justice, Fair pay, Value congruence, Time pressure, Performance feedback, Possibilities for learning and development, and Career perspective (e.g. Houtman, 2012; Schaufeli, 2015; Schaufeli, Bakker, & Salanova, 2006). For determining the dimensions of the (JD-R) model in the context of this study, the Fuzzy Delphi method was used, and the following discussion explains that. Burnout is the key pathologic health indicator in the JD-R model, and it is most operationalised as fatigue – the energetic component of burnout. Exhaustion occurs because of prolonged exposure to specific work demands such as high physical, emotional, and cognitive strain (Lesener, Gusy, & Wolter, 2019). Hence, work engagement focuses on the affective-cognitive state and may be defined as a pleasant, gratifying, work-related state of mind marked by energy, devotion, and immersion. The JD-R paradigm proposes two causal – basically independent – processes: health impairment and motivation (Archana, 2019; Zhu, Guo, Ai, Bai, & Zhao, 2018).

Data analysis in Fuzzy Delphi

The Delphi method (i.e. Delphi technique and fuzzy theory) was used for investigating the opinions of experts who know the area of this study. This method has been used to achieve anonymity, iteration, controlled feedback, and statistical group response. To adopt the fuzzy Delphi method, the number of experts should range from nine to fifteen. Therefore, this study targeted 15 experts with experience of ten years. This is due to the difference of views on this topic. This method consists of six steps starting with determining the importance of the variable by experts, then converting the linguistic variables to fuzzy numbers, followed by the third step: use the vertex method to compute the distance between the average and the distance between the average (Chang et al., 2011) .

$$\mathbf{d}\left(\tilde{\mathbf{m}},\tilde{\mathbf{n}}\right)=\sqrt{\frac{1}{3}\left[\left(\mathbf{m}_1-\mathbf{n}_1\right)^2+\left(\mathbf{m}_2-\mathbf{n}_2\right)^2+\left(\mathbf{m}_3-\mathbf{n}_3\right)^2\right]} \tag{1}$$

In the fourth step, according to Chang et al. (2011) , if the distance between the average and expert's evaluation data is less than the threshold value of 0.2, then all experts are considered to have achieved a consensus. Furthermore, among those m X n ratings of alternatives and n criteria weights, if the percentage of achieving a group consensus is more significant than 75% (Chang & Hsu, 2011), then go to step 5; Otherwise, a second round of survey is required.

The fifth step includes fuzzy evaluations:

$$\tilde{\mathrm{A}}=\begin{bmatrix}\tilde{\mathbf{A}}_1\\ \vdots\\ \tilde{\mathbf{A}}_{\mathbf{m}}\end{bmatrix}\ \text{where}\tilde{\mathbf{A}}_{\mathbf{i}}=\tilde{\mathbf{r}}_{\mathbf{i}1}\otimes\tilde{\mathbf{W}}_1\oplus\tilde{\mathbf{r}}_{\mathbf{i}2}\otimes\tilde{\mathbf{W}}_2\oplus\ldots\oplus\tilde{\mathbf{r}}_{\mathbf{in}}\otimes\tilde{\mathbf{W}}_{\mathbf{n}} \tag{2}$$

I = 1, … , m

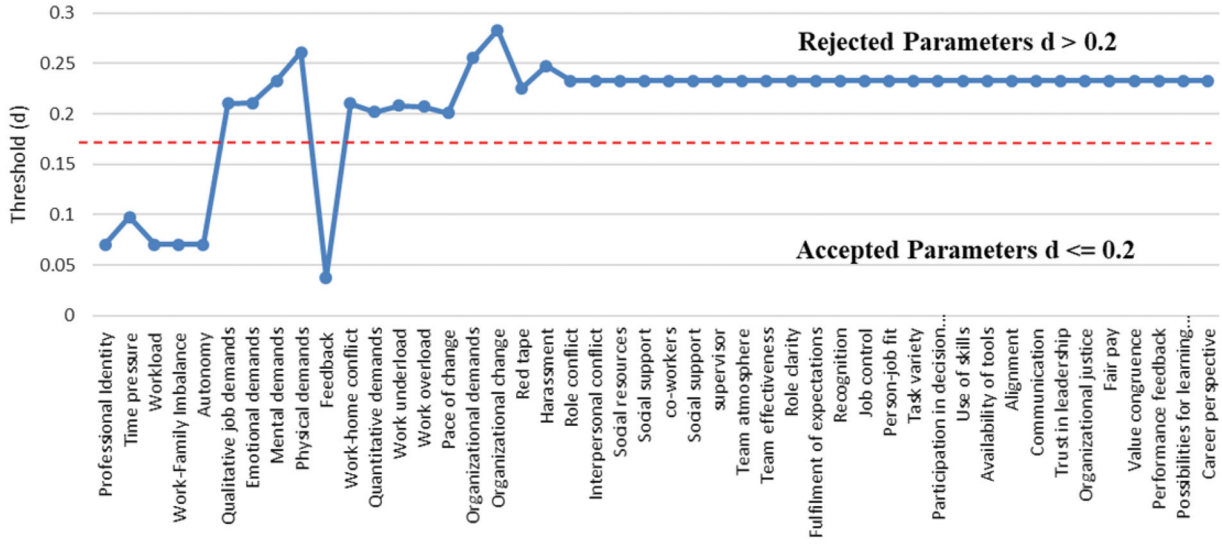

Figure 1. Rejected and accepted parameters based on a threshold value (*d*).

The six-step For each alternative option, the fuzzy evaluation $\tilde{A}_i = (a_{i1}, a_{i2}, a_{i3})$ is defuzzified by

$$\mathbf{a_i} = \frac{1}{4}(\mathbf{a_{i1}} + 2\mathbf{a_{i2}} + \mathbf{a_{i3}}) \tag{3}$$

The ranking order of alternative options can be determined according to the values of a_i.

The fuzzy Delphi Method seeks expert consensus using a Likert scale questionnaire format. The scores were converted into fuzzy numbers derived from a mathematical fuzzy Delphi formula. The linguistic variables were converted into fuzzy scales. The overall average of group consensus was 80%, which makes this iteration accepted. If the average group consensus is greater than 75%, then a consensus was achieved. If it's less than 75%, another survey iteration is required since the consensus was not achieved (Chang & Hsu, 2011). The following figure was reached based on fuzzy results, which indicates the most essential acceptable and rejected dimensions (Figure 1).

After that, the threshold (d) value was calculated, which equals the distance between the average fuzzy evaluation and the expert's evaluation. Decisions are made based on the value of d, and if d is lower than the threshold of 0.2, then this parameter will be accepted since expert consensus was achieved. If the d value is higher than 0.2, the parameter will be rejected, where we note the acceptance of six dimensions of the JD-R model. Previous studies agree upon these dimensions, and experts have rejected 47 because these six dimensions are more comprehensive and include most of the dimensions that have been omitted. As for the evaluation of fuzzy Delphi, the results show that the six accepted dimensions had a percentage greater than ten, which indicates the acceptance of these dimensions and the rejection of the others because their value is less than 10 (Chang & Hsu, 2011; Jabbar, Almayyahi, Ali, & Alnoor, 2020). Hence, based on the results of Fuzzy Delphi, this study focuses on three demands (time pressure, work-family imbalance, and workload) and two resources (autonomy and feedback) within the framework of the JD-R model. These have been incorporated into the model because of their importance in the industrial sector of Iraq.

Additionally, this study will assume a professional identity as one of the job resources (JD-R) models. According to Braine and Roodt (2011), the (JD-R) model act as a predictor to work identity. Therefore, testing a professional identity rather than work identity alongside the (JD-R) will be more logical in our study model. Figure 2 shows the proposed study model based on what was mentioned in the previous sections.

Professional identity and open innovation

Human resources have different professional identities because of their different positions in the organisations (Pratt, Rockmann, & Kaufmann, 2006). Individuals with unique knowledge and skills occupy higher positions and have more independence (Larson, 1977). These individuals are professionals because of their specific and unique

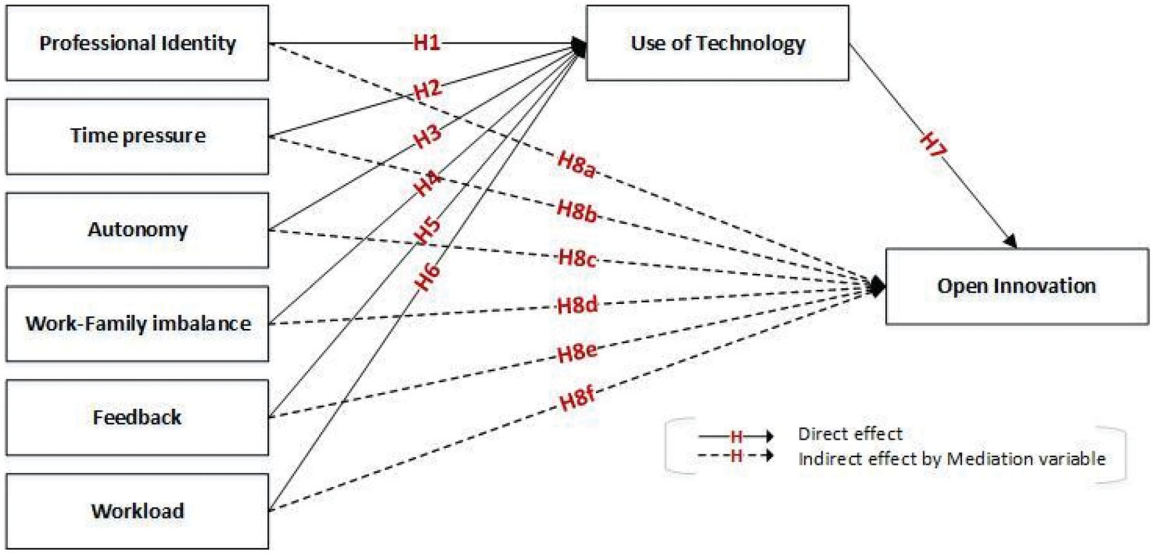

Figure 2. Conceptual framework.

skills and capabilities (Pratt et al., 2006). Professional identity is achieved through a sense of ownership of the job and helps to negotiate subjectivity, agency, and intentionality (Higgs, Barnett, Billet, Hutchings, & Trede, 2012).

Despite the incidents of professionals not sharing knowledge extensively with others, many studies have found the professional identity plays a critical role in stimulating open innovation (Ivanova & Popova, 2017; Lifshitz-Assaf, 2018). Moreover, knowledge must be essentially shared for collaborative and open innovation (Pauget & Wald, 2018). Many studies explain how professionals resist innovation (Lifshitz-Assaf, 2018). This study illustrates the professional identity can play an important role in adopting open innovation. Organisations must allow professionals to reconstruct their professional identities to induce open innovation (Alhamdi, Alnoor, Eneizan, Abdulla, & Abdulaali, 2019; Lifshitz-Assaf, 2018). Professionals willing to accept open innovation do not need to reconstruct their professional identity because their knowledge is aligned with open innovation requirements. Hence to evaluate the assumption of impact of professional identity on open innovation can be developed:

Hypothesis 1: professional identity is positively associated with open innovation.

Time pressure and open innovation

Human resources feel stressed when they are not available with enough time to complete the task. This is termed time pressure. It can be defined as a type of psychological stress that occurs when a person has less time available (real or perceived) than is necessary to complete a task or obtain a result (Demerouti, Bakker, & Bulters, 2004). To this end, time pressure is referred to an individual's periodic assessment of lacking enough time to complete a job.

Time pressure is a socio-environmental factor and relevant to an interaction between a person and a situation (Hsu & Fan, 2010). It has been found that time pressure, a factor in the organisational innovation climate, has a negative impact on employees' innovation adoptability (Hsu & Fan, 2010). Hence, time pressure happens when an employee is motivated and willing to perform a job, but the time does not allow them to exploit inherent knowledge to meet the demand of a job. In this way, time pressure is considered to affect negatively open innovation (Hsu & Fan, 2010) . Accordingly, we propose the following hypothesis that is in line with many previous studies.

Hypothesis 2: Time Pressure is negatively associated with open innovation.

Autonomy and open innovation

Autonomy refers to one's freedom or self-control to perform a job and make the relevant decision. Open innovation requires a continuous review of the job design processes, specifically job autonomy and appreciation

(Burcharth, Praest Knudsen, & Søndergaard, 2017). Autonomy provides the employee with more freedom and benefits from the knowledge resources (Burcharth et al., 2017), especially in the first stage of innovation (Pauget & Wald, 2018). Organisations should provide employees with an innovative culture that enhance employees' learning and decision-making capability. Decisions must be made collaboratively by involving employees from different levels to ensure organisational success (Burcharth et al., 2017). Several studies conclude that there is a positive effect for autonomy on organisation openness (Burcharth et al., 2017; Ladikas, Hahn, Hennen, Kulakov, & Scherz, 2019), and this leads to the following hypothesis:

Hypothesis 3: Autonomy is positively associated with open innovation.

Work-family imbalance and open innovation

Work-family balance is critical to increasing organisational productivity and employees' performance. Work-family balances align employees' corporate life with their personal life (Darcy, McCarthy, Hill, & Grady, 2012). In recent times, research on work-family relations has drawn the attention of researchers, especially with the entrance of more females in out-of-home employment. Researchers agree on the negative impact of work-life imbalance on innovation. Lacking work-family balance negatively influences an individual's emotional stability. Therefore, fostering innovation will require a support system at all levels, and this system will not succeed without employees being emotionally stable (Nahnfeldt & Lindberg, 2013; Wang & Song, 2019). The current study will try to contribute by testing this relationship to reach more profound results in explaining this phenomenon. To this end, we propose the following hypothesis:

Hypothesis 4: Work-life imbalance is negatively associated with open innovation.

Feedback and open innovation

Feedback is a tool for organisational behaviour modification (OB Mod) (Luthans, Youssef, & Rawski, 2011) and for increasing the ability to gain knowledge (Usman, Danish, Waheed, & Tayyeb, 2011). Therefore, managers try to ensure feedback reaches the relevant employees in time to modify organisational processes (Wooten & Ulrich, 2017). The feedback can explain the difference between the quality and efficiency of innovation processes. Accordingly, modifying positive behaviour resulting from feedback will be one factor in developing innovative work (Luthans et al., 2011). Feedback works as an input to the idea generation process, which is the first stage of the creativity and innovation process (Ding, Zhang, & Tang, 2019; Wooten & Ulrich, 2017). In this context, feedback will increase employees' capabilities to innovate in performance (Usman et al., 2011). The usefulness of feedbacks develops at the individual level to enrich the quality of the collective and organisational processes. The success of developing individual feedback to other levels relies on the extent of acceptance by departments.

On the other hand, over time, workers will become frustrated and not express feedback. Effective feedback works as a channel of communication, motivation, and persuasion. Several studies confirm the positive effect of feedback on innovation (Luthans et al., 2011; Sukar & Ahmed, 2019; Wooten & Ulrich, 2017). Hence, the following hypothesis is posited:

Hypothesis 5: Feedback is positively associated with open innovation.

Workload and open innovation

The workload is a magnitude of work assigned to an employee. There is a distinction between the actual amount of work and an individual's perception of the workload (Jex, 1998). Therefore, the workload can be classified as quantitative (the amount of work to be done) or qualitative (the difficulty of the work) (Smith-Jackson & Klein, 2009). The workload falls into two major categories. First, it may be in the main (core) tasks of the job. Second, it may be in the secondary tasks of the job (Gawron, 2008). We assume innovation is a primary task of the job. Therefore, the workload in the main tasks may help increase creativity (depending on person-job fit) (Smith-Jackson & Klein, 2009; Sousa, Martins, & Sousa, 2019).

On the other hand, focussing on the secondary tasks of the job may distract the employee's minds and reduce their ability to acquire the knowledge necessary for innovation. Therefore, the term workload is specific to increasing the secondary tasks of a job beyond the employee's capacity. The workload resulted from an increase in the main tasks of the job. Moreover, the workload will serve as a prelude to developing the employees' level of increasing innovation. Several studies indicate a negative impact of workload on innovation (Agyapong, 2021; Kellogg, 2002; Sharma, 2021). Accordingly, we can assume the following hypothesis:

Hypothesis 6: Workload is negatively associated with open innovation.

Mediator role of use of technology

New technology was one of the most important reasons for facilitating the emergence of open innovation (Chesbrough, 2003b). As stated earlier, we consider using technology as a mediator in our proposed study models (Kim & Christensen, 2017). This is important to discuss the extent of human–technology interaction (e.g. socio-technical approach). In this context, the use of technology positively affects performance (Demerouti et al., 2001). Moreover, the increased use of technology has dramatically helped preserve knowledge sharing (McDermott, 1999). This participation makes the process of acquiring and employing work knowledge easier. However, many employees perceive technology as another job demand instead of a reaction to the high job demand level (Alnoor, Al-Abrrow, Abdullah, & Abbas, 2020). Therefore, technology is a vital explanatory factor in the relationship between a demands-resources model and open innovation. To this end, the following hypotheses are suggested:

Hypothesis 7: The use of technology is positively associated with open innovation.

Hypothesis 8: Use of technology has a mediating role between professional identity and job demands-resources model in open innovation.

Method

Sample and procedure

This study was conducted within the private industrial sector in southern Iraq. Seventeen companies of varying works were targeted in this sector ranging from the building and construction industry to the garment industry, food, tools, and electrical equipment. The data was collected through randomly distributed questionnaires among 300 professional employees (engineers, accountants, etc.). Two hundred sixty-six employees filled in questionnaires, out of which six were excluded due to incomplete evidence that set the total data at 260 responses. We obtained an 87% response rate which is commonly accepted in cross-sectional studies. According to PLS-SEM modelling, the sample size of more than 200 cases is good enough to get relevant results (Hair, Black, Babin, & Anderson, 2010).

The problem of bias and subjectivity is common in behavioural research. To address this issue, preventive measures were considered, such as guaranteeing the confidentiality of information for respondents, formulation of some inverse items (back-translation), separating the sources of information on the independent, dependent variables, and a 360-degree employee evaluation survey was formulated to eliminate the problem of bias. Moreover, after collecting data, we tested standard method bias using Harman's single-factor test (Podsakoff, Mackenzie, Lee, & Podsakoff, 2003). This test was most common in organisational studies with a 65% utilisation rate (Aguirre-Urreta & Hu, 2019). According to Harman (1976), when the variance for the first factor exceeds 50%, this indicates a bias problem in the data. By performing the analysis in the SPSS software, we obtained a variance of not more than 25%, indicating there was no bias problem in the sample responses.

The survey was conducted during the second quarter of 2019. The sample size included 77% (200) males, 23% (60) females, 19% single, 33% married without children, and 48% married with children. Respondents were chosen from a variety of jobs, including engineers (18%), craftsmen (35%), accountants (19%), professionals dealing with the law (15%), and chemists and physicists (13%). Respondents' ages ranged from 20 to 65 years, with an average age of 38 years, while their education levels are divided as follows: below secondary (13%), secondary (7%), diploma (20%), bachelor (50%), masters or PhD (10%). Responses were obtained on a five-point Likert scale ranging from '1' (strongly disagree) to '5' (strongly agreed).

Measures of variables

Professional identity: This variable was measured through a scale developed by Adams, Hean, Sturgis, and Clark (2006), and its one-dimensional variable consists of 9 items (e.g. 'I feel like I am a member of this profession.'). This is a measurement of good reliability ($\alpha = .82$). **Time pressure:** An eight items scale (one-dimensional variable) was created to measure this variable; four out of them are from Linzer et al. (2000), and the remaining half are from Kinicki and Vecchio (1994) (e.g. 'Work rarely encroaches on my time.'). **Autonomy:** We used Breaugh's (1999) scale in this regard. This scale consists of three dimensions, with nine items (three items for each dimension), which are: Method Autonomy ($\alpha = .93$) (e.g. 'I am allowed to decide how to go about getting my job done.'), Scheduling Autonomy ($\alpha = .88$) (e.g. 'I have control over the scheduling of my work.'), and Criteria Autonomy ($\alpha = .83$) (e.g. 'I have some control over what I am supposed to accomplish.'). **Work-Family imbalance:** Carlson, Kacmar, and Williams (2000) scale were used to measure Work-Family imbalance. It is a one-dimensional scale, and it consists of 5 items (e.g. 'The demands of my work interfere with my home and family life.'). **Feedback:** Andrews and Kacmar (2001) scale was adopted to measure the feedback. This consists of five dimensions, with 15 items (three items for each dimension): feedback from task, self, supervisor, co-worker, and organisation. (e.g. 'My particular tasks and duties consistently provide job performance.' And 'My feelings and ideas consistently provide job performance.'). This measurement has acceptable reliability ($\alpha = .77$). **Workload**: This was measured through a scale developed by Pickup, Wilson, Norris, Mitchell, and Morrisroe (2005) and its one-dimensional variable consisting of 9 items (e.g. 'Work is not demanding at all.'). **Use of Technology:** We used Al-Gahtani, Hubona, and Wang (2007) scale in this regard. This consists of six dimensions and 21 items: three items for subjective norm, facilitating conditions, and behavioural intention dimensions (e.g. 'Most people who are important to me think I should use computers.', 'A central support was available to help with computer problems.', and ' I predict I will continue to use computers on a regular'.), four items for performance expectancy, effort expectancy, and use behaviour dimensions (e.g. 'I find computers useful in my job.', 'My interactions with computers are clear and understandable.' and ' On an average working day, how much time do you spend using computers?'.). The coefficient of reliability for all dimensions ranged from .76 to .90. **Open Innovation**: This variable was measure based on Remneland-Wikhamn and Wikhamn (2011), which develop this scale, and its one-dimensional variable consists of 6 items (e.g. 'New ideas are readily accepted here.'). This measurement has good reliability at $\alpha = .83$. **Control Variables**: It is vital to use demographic variables in this type of study (especially a JD-R model). Gender, age, marital, education, and experience variables were included in the study model. The value of gender (1) was set for male; (2) for female, the value of age (1) for less than 30 years; (2) for 31–40 years; (3) for 41–50 years; (4) for 51–60 years; and (5) for more than 61 years. Similarly, the value of (1) for marital (2) for single, (3) for married without children and (4) for married with children. Likewise, to indicate education, the value of education (1) showed below secondary; (2) secondary; (3) diploma; (4) bachelor; and (5) masters or PhD, and the values of experience ranged: (1) less than five years; (2) 6–10 years; (3) 11–15 years; (4) 16–20 years; and (5) more than 21 years.

Results

Descriptive statistics

Table 1 showing the coefficient of alpha-Cronbach has exceeded 0.7 for the eight variables of the study model. This indicates data reliability and internal consistency are acceptable. Besides, the result indicates the three independent variables have a positive correlation to the mediator variable and the dependent variable ($p < .01$) (i.e. professional identity, autonomy, and feedback), and three independent variables are in a negative correlation to

Table 1. Descriptive statistics.

Variables	Mean	S.D	1	2	3	4	5	6	7	8
1. Professional Identity	3.11	.688	(.884)							
2. Time pressure	3.16	.548	−.322**	(.819)						
3. Autonomy	3.03	.590	.662**	−.422**	(.870)					
4. Work–Family imbalance	2.97	.618	−.334**	.478**	−.392**	(.791)				
5. Feedback	3.07	.591	.651**	−.292**	.632**	−.208**	(.938)			
6. Workload	2.75	.636	−.237**	.525**	−.466**	.551**	−.331**	(.893)		
7. Use of Technology	2.82	.624	.547**	−.373**	.468**	−.441**	.454**	−.358**	(.966)	
8. Open Innovation	2.83	.659	.425**	−.430**	.537**	−.451**	.563**	−.412**	.729**	(.899)

$N = 260$. Alpha reliabilities appear in parentheses; ** $p < .01$.

the mediator variable and the dependent variable ($p < .01$) (i.e. time pressure, work-family imbalance, and workload). These results provide initial support to the study hypotheses. The means value ranged for variables between (2.75 and 3.16). Standard deviations were of good value.

There is a need to ensure there is no multicollinearity problem, especially in the model of this study, which consists of several independent variables. In addition, the value of the correlation between variables does not exceed .90, the value of the variance inflation factor (VIF) is counted. Generally, in large models, a value exceeds ten indicates the problem exists, while a value less than 3 is acceptable in simple models (Graham, 2003).

When performing the test, results are obtained in Table 2. This indicates the value of 3 is not exceeded for all independent variables, whether with the mediation or dependent variable. Hence, there is no concern about multicollinearity.

Assessing the model fit

Structured equation modelling was used based on Amos V.24. We employed a maximum likelihood procedure for testing two models. Although the study model was theory-driven rather than data-driven, we desired to compare the two models. The first includes six independent variables (i.e. professional Identity, time pressure, autonomy, work-family imbalance, feedback, workload) and one mediation variable, which is the use of technology. The second involves an independent variable and six mediation variables. According to Widman and Thomson (2003) , Chi-square/df must be less than 2, RMSEA value must be less than .08, and CFI, TLI, and NFI values must exceed .90. In the first model (A), we made the six variables independent and used technology as a mediation variable (theory-driven model). In this model, the results were acceptable and good. The results were CMIN/df = 1.9, RMSEA = .077, CFI = .911, TLI = .905, and NFI = .904.

The second model (B) hypothesised that technology impacts open innovation through the mediator role with the other six variables (professional Identity, time pressure, autonomy, work-family imbalance, feedback, workload). The results were CMIN/df = 3.1, RMSEA = 1.2, CFI = 874, TLI = 792, and NFI = 774.

Table 3 illustrates the indicators' values did not reach the acceptable values for model B. However, model A was an acceptable value and indicated a better match between the data and the model better than the second model (B) (Hair et al., 2010).

Hypotheses tests

The path analysis (Amos V.24) was conducted for verifying the direct and indirect relationships between the variables. For testing indirect effect hypotheses, we relied on the Bootstrapping feature of the Amos program. For indirect hypotheses test (by mediation), it is a complete mediation if the direct hypothesis is unaccepted (the independent variable on the dependent variable with the mediation variable in the model). At the same time, it is a partial mediation if the direct hypothesis is accepted. Table 4 shows the results of the study hypothesis test.

As for the first six hypotheses (path **a**), all were accepted. The results of Table 4 confirm there is a positive effect of professional identity, autonomy, and feedback on the use of technology (H1, H3, H5: $p < .01$). While

Table 2. Multicollinearity test.

Independent variables	Tolerance	VIF
Professional Identity	.759	2.317
Time pressure	.695	2.440
Autonomy	.630	2.586
Work–Family imbalance	.535	2.868
Feedback	.771	2.297
Workload	.691	2.446

Table 3. Assessing the models fit.

Models	Chi square (sig)	df	CMIN/df	RMSEA	CFI	TLI	NFI
A	3.8 (0.08)	2	1.9	.077	.911	.905	.904
B	6.2 (0.03)	2	3.1	1.2	.874	.792	.774

CMIN/df: minimum discrepancy; CFI: Comparative Fit Index; TLI: Tucker-Lewis Index; NFI: Normed Fit Index; RMSEA: root mean square error of approximation.

Table 4. Test hypotheses.

Independent variables→	Use of technology path a	Open innovation (Direct effect)	Total effect	Indirect effect
Gender	−.045	−.003		
Age	.095	−.047		
Marital	−.075	.025		
Education	.109*	.090		
Experience	−.052	.102*		
Professional identity	.234**	.053	.159**	.106**
Time pressure	−.213**	−.039	−.135*	−.096*
Autonomy	.399**	.173*	.354**	.181**
Work–Family imbalance	−.221**	−.143*	−.244**	−.101*
Feedback	.198**	.112*	.201**	.089
Workload	−.124*	−.033	.089	−.056
Use of technology	–	.454*** (Path b)	–	–

*$p < .05$, **$p < .01$, ***$p < .001$.

there is a negative effect for time pressure, work-family imbalance, and workload on the use of technology (H2, H4: $p < .01$; H6: $p < .05$). In addition, there is a positive effect of the use of technology on open innovation (H7: $p < .001$) (path **b**). Bootstrapping in Amos used to test the indirect effect hypotheses (H8), we find evidence there is a positive effect of professional identity and autonomy on the open innovation by the use of technology (H8a, H8c: $p < .01$), a negative effect of time pressure and work-family imbalance on the open innovation by the use of technology (H8b, H8d: $p < .05$). As for the control variables, we only obtained education on technology and expertise on open innovation. The results in Table 4 showed the use of technology has a full mediated effect between professional identity (H8a), time pressure (H8b) and open innovation. In contrast, we found partial mediation in the use of technology for autonomy (H8c), work-family imbalance (H8d) on open innovation. Finally, we did not find a mediating role for the use of technology between feedback, workload and open innovation.

Discussion

Recent experiences confirm closed innovation establishes a risk to manager jobs because it is more likely to fail than open innovation (Chesbrough, 2003a). Successful managers realise professional identity is the most compelling feature for developing innovation at the workplace. Hence, innovation is not associated with the use of technology only. Still, it is induced through skills, workload, stress, time, work-life balance and other factors that impact the cognition and behaviour of employees (Wooten & Ulrich, 2017). Many previous studies advocate it is necessary to focus upon personal motivation and workplace environment to boost individuals' instinct towards the use of technology to improve performance.

The current study found variables such as feedback, professional identity and autonomy are having positive relations with the use of technology. However, workload, time pressure and family imbalance are not positively related to the use of technology. It further suggested that stress and time pressure were the main hurdles that restricted employees' motivation towards adopting the technology. Workload did not allow the individuals to focus upon the other features that are part of their professional development (i.e. heavy workload). However, organisational resources and management support are essential features that influence the individuals or employees to adopt the new technology and use the available technology to meet personal and organisational objectives considerably. The use of technology is directly associated with open innovation, increasing personal skills, differentiation, enhancing innovative strategies, and developing new projects to have a competitive market advantage (Humphrey et al., 2015). Personal motivation, management of time, prioritising the work, life-work balance, and developing individual' mind might motive them towards the attainment of organisational objectives (Schaufeli & Taris, 2014). Previous studies suggest that cognition, motivation, lack of stress, less workload, and work-life balance are vital features that encourage individuals to innovate novel ideas (Darawad et al., 2015). The findings of this study suggest the individuals can develop a balance amongst their life and work context by reduces stress, manage time, and acquire capabilities.

Thus, developing open innovation is an integrated process between human resources and the management of an organisation by recognising and providing requirements that contribute to discovering and exploiting knowledge from outside and within the organisation to formulate and implement innovation. In this context, the results should be discussed, considering the effects of the COVID-19 pandemic. In the last 18 months, with the

outbreak of the COVID 19 epidemic, jobs have become more exhausting for workers. The layoffs of workers due to financial losses doubled the pressure and workload of the workers (Abbas et al., 2021; Barello et al., 2021). In addition, there is another pressure which is the use of technology (Ren, Cao, & Chin, 2020). The pandemic had the greatest threat to the industrial sector through economic and social effects (Khan, Niazi, Nasir, Hussain, & Khan, 2021). The pandemic of COVID-19 raises stress and time pressures of work (Sokal, Trudel, & Babb, 2020; Thielsch, Röseler, Kirsch, Lamers, & Hertel, 2021). However, many recommendations have been made about how managers should deal with workers during the pandemic. Hence, the job demands-resources model contributes to building a robust theoretical framework to reach results that closely match reality. It contributes positively to obtaining more excellent performance from employees (Al-Abrrow et al., 2021). Under these complex circumstances, open innovation will be a solution for managing organisations (Dahlander & Wallin, 2020). In other words, it will be considered to face crises and pandemics.

Limitation and future research

This study was adopted a quantitative study based on a survey to collect the data. This study has selected the variables are used by the different authors for similar studies. However, some essential variables may have been omitted because of professional limitations and a lack of resources to access information. Hence, further, the transversal nature of the data collection method hinders the appropriate assessment of users' behavioural development. Therefore, the longitudinal approach is appropriate because it could test the strength of the relationships.

Similarly, a comparative study between two different sectors will explain the phenomenon in more depth. Future studies may modify the proposed model by the emergent situations to stretch the theoretical and practical implications. The study was conducted at the beginning of the COVID 19 pandemic. Therefore, we believe testing the job demands-resources model will be very necessary to enhance the organisation effectively and efficiently.

Conclusion

The role of technology is highly effective and essential in terms of organisational performance and attaining strategic objectives. The organisation should bring their potential resources to involve employees to get new skills and use technology. To this end, training programs and other activities are necessary to create a professional identity among the individuals. However, management should develop flexibility at the workplace, manage the employees' responsibilities, reduce the stress, and develop work-life balance. Finally, attention to human resources considering the pandemic will be more critical and necessary. The findings of this study showed that job demands-resources directly impact open innovation and indirectly affect innovation through the moderator role of the use of technology. However, there was no direct effect of professional identity and workload on open innovation. Finally, technology has a full moderating in the relationship between job demands-resources and open innovation.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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