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A conceptual model for adoption of BIM in construction projects: ADKAR as an integrative model of change management

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ABSTRACT

The use of Building Information Modeling (BIM) technology has facilitated storage and reuse of information throughout the lifecycle of construction projects. Despite its benefits, construction industry has witnessed several obstacles in adopting BIM technology in terms of people management. This paper investigates how ADKAR model (an acronym for five stages of effective lasting people change: awareness, desire, knowledge, ability, and reinforcement) can contribute to successful adoption of BIM in construction sector. This study was conducted in two main stages: a rigorous literature review process followed by data collection using eight in-depth interviews with construction project managers. Data was analyzed following Bryman and Bell's [(2007). Business Research Methods. Oxford: Oxford University Press] steps for thematic analysis. The results from interviews combined with results of literature review contribute to the development of an integrated conceptual model of change management. The conceptual model identifies two main phases of determinants for successful change management process towards the adoption of BIM technology using ADKAR model. Firstly, engineers as designers with different specialist (i.e., architectural, civil, electrical, mechanical), engineers as contractors, and clients require the enhancement of all five dimensions of ADKAR for a lasting change. Secondly, government requires the enhancement of three main dimensions of ADKAR model, namely awareness, desire, and reinforcement.

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1. Introduction

The construction industry is one of the most important sectors contributing to the economy of any country (Lindblad and Vass 2015). It includes several branches such as building construction, infrastructure construction and industrial construction. However, the construction sector is one of the biggest fragmented industries in the World (Isikdag et al. 2007). Any construction project contains activities from planning, design drawings, time scheduling, cost estimation and bidding to the execution and maintenance of the project. This would imply that mutual communication between stakeholders in the project is a complex process (Bryde, Broquetas, and Volm 2013). Attempts have been made on improving mutual communication and productivity in construction projects through utilisation of information and communication technologies. One of these technologies that have been the centre of the focus is the BIM (Azhar, Kang, and Ahmad 2014). Due to the

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offerings of the BIM technology, the coordination between stakeholders can be improved using shared design models. BIM is a tool that provides storage and reuse of overall building information throughout the lifecycle of the project (Vanlande, Nicolle, and Cruz 2008). It allows for on-demand retrieval and management of information between different stages of the construction project by stakeholders. Hence, BIM unlocks more efficient methods of designing, creating and executing projects integrally.

Despite the well-documented benefits of BIM adoption, the construction industry has been reluctant in implementing the BIM work paradigm as it is still dependent on traditional document-based methods (Liao and Teo 2018). Recent research suggests that slow implementation of BIM in construction projects is caused by stakeholder's resistance to change (Musleh 2018). According to Juan, Lai, and Shih (2017), the source of resistance to BIM among participants in construction projects is due to the fact that different participants have to adapt to a new delivery process away from their comfort zones. Thus, people management of the BIM adoption process is key for successful uptake of BIM (Liao and Teo 2018). However, there seems to be severe lack of knowledge on what types of human-side changes that are required to accompany the implementation of BIM in construction projects, if the benefits of BIM are to be met (Lindblad and Vass 2015). This is further confirmed by recent BIM research that is mainly focused on tackling technical difficulties of implementing the technology (e.g. Grilo and Jardim-Goncalves 2010; Hallberg and Tarandi 2011), and more widely on identifying the benefits of using BIM technology (e.g. Barlish and Sullivan 2012). Furthermore, Ding et al. (2015) argue that current mechanisms for BIM adoption in construction industry lack both stakeholder's personal motivation factors (i.e. the extent to which people are motivated to use BIM) and external motivation factors (i.e. the availability of government policies and educational programmes for BIM adoption). In the same vein, Gu and London (2010) asserted that the challenge for BIM research community lies in creating an enabling environment that integrates human-side change issues with BIM technical implementation projects. Hence, there is an urgent need for research that explores practices for managing BIM adoption in the context of people change management. Based on this, this paper aims at closing this gap by investigating how the ADKAR model of people change management can contribute to the successful adoption of BIM in the construction sector. ADKAR is an acronym that stands for five stages required for effective people change: awareness, desire, knowledge, ability and reinforcement. The ADKAR model provides a tool for change that is effective on an individual level. The model is also designed to help groups of people and the entire organisation to navigate successfully through change (Calder, 2013). The five stages covered by the ADKAR model must be leveraged sequentially during the change process for the best possible outcomes. The power of the ADKAR model lies on its ability to focus on the first dimension out of the five dimensions that is the root cause of failure of change (Hancock 2010; Boca 2013). The paper suggests a conceptual model for using the ADKAR model of change to enhance BIM implementation in construction projects through two main phases of determinants for a successful change management process. Firstly, engineers as designers with different specialist (i.e. architectural, civil, electrical and mechanical), engineers as contractors and clients require the enhancement of all five dimensions of ADKAR for a lasting change. Secondly, government requires the enhancement of three main dimensions of ADKAR model, namely awareness, desire and reinforcement as it is the responsibility of engineering firms to offer training for their engineers that can equip them with right level of knowledge and ability to use BIM technology. Therefore, the research question to be answered in this study is: 'How does the ADKAR model of change management enhance BIM adoption process in construction projects?'.

This paper is subdivided into six sections. Section 2 introduces a literature review and summarises studies that addressed BIM adoption obstacles, change management and ADKAR model of change. The third section explains the research methodology followed and the main findings achieved. The fourth section proposes a BIM implementation conceptual model to be applied in construction projects. The fifth section provides findings discussions and practical implication. Finally, the last section summarises the conclusions of the work and proposes future research directions.

2. Literature review

2.1 Obstacles to managing people in the process of BIM adoption

Adopting BIM requires changing the traditional way of the mindset of work into creative innovations (Gu and London 2010). By applying BIM, new tasks and processes have to be adopted by designers, contractors and other stakeholders in the construction project. Hence, to accept BIM effectively, all stakeholder of a construction project should understand the usefulness of adopting BIM to agree with the change. However, this process of human-side change is faced with numerous obstacles (Liao and Teo 2018). According to Gamil and Rahman (2019), the main challenges facing the implementation of BIM technology in Yemen Construction sector are related to people change management issues including improper introduction of BIM technology to construction project participants, and, thus, lack of awareness of employees about the benefits that can be reaped from this technology. Authors also explained that government support and enforcement of BIM in the construction industry can play a major role in mitigating people management issues during the change process. Similarly, Diaz (2016) explained that fear of the unknown outcomes generated by BIM coupled with lack of desire to transform project practices constitute major hindrances to the BIM adoption efforts in the construction industry. This was asserted by Hamid et al. (2018) who found that the Malaysian construction industry needs to improve awareness and knowledge of BIM through proper BIM training to remove critical barriers of its implementation.

In this regard, the theory of the technology acceptance model (TAM) was widely used in the literature to understand factors affecting BIM adoption in the construction industry (e.g. Lee, Yu, and Jeong 2013; Lee, Yu, and Jeong 2015; Ramanayaka and Venkatachalam 2015; Batarseh and Kamardeen 2017). The theory TAM, introduced by Davis (1989), is focused on how individual users come to accept and utilise a technology. It explains that an individual's intentions for the use of new technology are primarily influenced by individual's perceived ease of use and perceived usefulness (Manis and Choi 2019). For instance, Yuan et al. (2019) used TAM's dimensions of individuals' ease of use and perception of the usefulness of BIM technology to investigate the factors affecting construction project owners' BIM adoption in the Chinese context. The authors found that BIM technical offerings and government BIM policies have a positive influence on individuals' perceived usefulness, and that social influence of authoritative colleagues and BIM technical offerings have positive influence on perceived ease of use. Also, Batarseh and Kamardeen (2017), in their study of the use of TAM for BIM adoption in the construction industry, found that individual's willingness to accept and use BIM technology is strongly linked with awareness of individuals about the usefulness of BIM technology, how easy the use of BIM technology, social influence in enhancing skills required and availability of facilitating conditions related to organisational infrastructure to reinforce adoption. Similarly, Sanchís-Pedregosa, Vizcarra-Aparicio, and Leal-Rodríguez (2020) examined factors affecting the adoption of BIM technology in Peruvian Construction industry using the theory of TAM. The authors found that perceived usefulness is the most significant factor affecting individuals' behavioural intentions to use BIM. Despite its usefulness in identifying factors supporting the adoption of BIM, the theory of TAM has some limitations as it does not reflect a variety of specific factors to deal with individuals' task environments constraints (Yuan et al. 2019); such as individual's skills promotion and desire to support the BIM adoption. According to Legris, Ingham, and Collerette (2003), the TAM model lacks variables related to supporting human-side change necessary for enhancing technology acceptance. This was supported by Criminale and Langar (2017) who studied 36 barriers of implementing BIM technology in the United states' construction industry. The authors found that the majority of those barriers were related to people management issues at construction project organisational level. The most pressing challenges they found were fear of unknowns of BIM, employees' belief that BIM is waste of time and resources, lack of awareness about what BIM is and what it can deliver, lack of ability of using the software and weakness of management support for the new technology due to costs associated with it.

Whereas Meganathan and Nandhini (2018) reported that the lack of experiences, knowledge, skills, trained employees, and absence of change management models are the main challenges for adopting BIM in the Indian construction industry. At a more subtle level, Zahrizan et al. (2013) identified that unwillingness to change, and apparently resistance to change, were the main barrier to BIM adoption in Malaysia, and attribute this to the shortfall of proper change management models to deal with this resistance in the construction industry. Also, Kiani et al. (2015) pointed out that resistance to change and unsupportive culture of BIM implementation in the Iranian context require integrated models of change management that can enhance stakeholders' willingness and enthusiasm to use BIM technology. Musleh (2018) stated that apart from financial and technological difficulties, BIM implementation should be studied from the perspective of change management and organisational change theories to deal with barriers related to people management during the change process. This was emphasised by Liao and Teo (2018) who explained that people management in the BIM implementation process should be approached using organisational change management theories. The current paper intents to respond to this need by investigating the offerings of the theory of the ADKAR model of change management to the BIM implementation in the construction industry.

2.2 ADKAR model of change management

Gover and Duxbury (2012) defined organisational change as the process of adjusting the organisation to changes in the surrounding environment. Thus, it is a process of departing away from a familiar state to a new unfamiliar state (Canning and Found 2015; Allaoui and Benmoussa 2020). It is the work the Kurt Lewin that coined the concept of organisational change through the development of his 'filed theory' (Burnes and Cooke 2013). The field theory examines individuals' patterns of interaction with his/her surrounding environment (Lewin 1951). This conceptualisation has also given prominence for the intergroup relations at the workplace where the individual belongs; also known as social groups (Lehmann 2017). According to Lewin (1947), interpreting change requires the understanding of psychological forces and actions of individuals within their social groups. Accordingly, and based on Lewin's (1951) theory, organisational change will achieve a greatest success when there is a connection between individuals' perception and collective meaning. This view has fuelled the development of 'coordinated management of meaning' theory by Pearce and Cronen (1980) which portraits the role of communication as vital in mediating the way in which individuals comprehend, understand and identify with organisational practices and procedural changes. As pointed by Kotter and Schlesinger (1989), communication efforts with individuals and within groups in organisations is not always a guarantor in order to make sense of the changes collectively, and this often run into some levels of human resistance. Therefore, a major problem in the organisational adjustment process is people lack of readiness for change (Thakur and Srivastava 2018). In this situation, change management is required to manage organisational change projects successfully (Lee et al. 2017; Maes and Van Hootegem 2019). Change management can be defined as an integral set of processes and techniques to effectively manage human resources throughout the entire organisational change project (Hiatt 2004). Hiatt and Creasey (2012) explained that individuals are the starting point for change. So, to achieve a successful change for groups of employees and the organisation as a whole, all individuals within the organisation must change. In fact, the process of changing individuals to support organisational change, such as BIM adoption, is not straightforward, but can be viewed as a complex process of human development (Liao and Teo 2018). According to Karp and Helgo (2008), this process of human development during change is not an easy journey of moving from one stable step to another, but a journey that requires careful exploitation of supportive models. Among these models are Lewin's three-step model of unfreeze, change and refreeze (Lewin 1947), and Kotter's eight-step model (Kotter 1996). Both models are based on predictable, reducible steps that allow managers to move from a current state towards a future state. However, these two models have been criticised for not being able to track the progress of the change transformation among individuals. They also lack considering personal feelings and experiences which may lead to a division among the group (Kreitner and Kinicki 2007; Hussain et al. 2016). In this research, the ADKAR model of change will be considered as it focuses on dimensions of change process that are effective on an individual level (Hiatt 2006; Budiwati and Langi 2013). These same dimensions are designed to be applied to larger groups of people or even the entire organisation (Hiatt and Creasey 2012). The power of this model lies in its ability to identify the root cause of people change failure, and where the change process is breaking down (Boca 2013). Therefore, it focuses the attention on actions that will yield the highest chance of change success (Budiwati and Langi 2013). ADKAR represents five steps in the change process and must be done in sequence to achieve the intended change. Hiatt and Creasey (2012) explain these steps as the following:

(1) Awareness of the need for change: in this first stage, individuals must be given enough information about what needs to change and the reason behind the change. Questions that would come into one's mind are: 'What are the risks if individuals are not going to change? And what are the reason for change?' Having clear answer for these questions can leverage individuals' awareness and will help them develop a desire to change (Calder, 2013).
(2) Desire to participate and change: once awareness of individuals is built around what needs to be changed, then it is vital to leverage their desire to support the change and be involved with it. This second stage is critically important as it can contain resistance against the change. 'A common mistake made by many business leaders is to assume that by building awareness of the need for change they have also created desire' (Hiatt 2006). Hiatt and Creasey (2012) see that a question of 'What must be done to create desire?' should be asked during the change process. To create adequate levels of desire among individuals, past organisational success stories can be utilised, in addition to illustrating how the change will benefit individuals (Calder, 2013).
(3) Knowledge on how to change: this stage involved sharing detailed information with individuals about how to create the change. Such information should include details about elements of the surrounding environment that will be replaced and the type of systems and behaviours that will be implemented as part of the change programme (Budiwati and Langi 2013). Sharing such information is important as it will allow individuals to start to conceptualise the things they need to do (Calder, 2013).
(4) Ability to implement required skills: This stage involves the actual implementation of the knowledge gathered in the previous step on reality. Thus, it is imperative at this stage that individuals are given an adequate level of supervision and mentoring to help them implement actions correctly (Hiatt and Creasey 2012). Therefore, ability could be achieved through implementing the new procedure and by additional coaching, practice and time.
(5) Reinforcement to sustain the change: at this final stage, individuals need to know if what they are doing is delivering the desired outcomes. Hence, a major part of this stage is supervisors' reward of individuals desirable behaviour and actions. Individuals who face difficulties in creating the change will only keep following the new actions of the change programme when their progress is recognised and acknowledged (Calder 2013).

Apparently, when this model is applied to organisational change, it will allow managers to focus their efforts on actions that will enhance individual change and therefore achieve organisational targets (Kiani et al. 2015), which is in the case of this research adopting the BIM technology in construction projects.

3. Methods and findings

Data collection in this study was initially conducted using a rigorous literature review process. The review of literature allowed for the identification of the main challenges of adopting BIM technology in the construction industry, and it also allowed for capturing the virtues of the ADKAR Model and its power in identifying and focusing on the root cause of change failure. Further, qualitative data were also collected through eight face-to-face in-depth interviews with construction project managers and practitioners in Palestinian construction industry. Each interview lasted for 50 min on average. Interviews were tape-recorded and transcribed as soon as they were completed. To ensure the reliability of interviews' data, a guiding protocol was utilised as a backup to help in following major concepts during interviews. The thematic analysis approach introduced by Taylor and Bogdan (1984) was used to analyse the interviews' data. This process of data analysis followed Bryman and Bell's (2007) steps. These steps explained as follows:

- First, reading through transcripts of interviews to identify leading theoretical topics available.
- Second, leading theoretical topics, also known as codes, were then used to list a set of topics that represent a general meaning of what has been said in the interviews.
- Third, revising transcripts to find codes with common basic themes.
- Finally, themes with affinity were identified are then clustered together to form central themes.

The main codes devised from interviews and the central themes generated are shown in Table 1. Two central themes were found, and these are explained below.

3.1 Theme 1: role of BIM advantages dissemination and education

The purpose of this theme is to focus on BIM's benefits for the construction projects and how these benefits can be used to enhance awareness and desire of construction projects' employees to adopt BIM. Almost all interviewees indicated that BIM has several benefits that must be explained and taught for construction projects' employees to adopt BIM technology. According to them, knowledge dissemination about BIM benefits should start with government support and enforcement to include BIM in the education curriculum for engineers and designers. For example, a construction project management stated that

> current engineering curriculum that is relevant to AEC does not consider BIM teaching for the next generation of AEC engineers. In best cases, the current curriculum offers limited education for AEC engineers about BIM but not totally integrated in the offered courses.

However, all interviewees explained that BIM education should also be supported by offering seminars and educational workshops by engineers' associations and contractors unions. Interviewees

Table 1. From codes to central themes.

Codes	Issues discussed	Central themes
• Benefits dissemination • Government role • Education	• Role of benefits in the awareness and desire creation • Government role in enforcing educational curriculum of BIM • Engineer's associations and contractor unions' role in BIM education	Role of BIM advantages dissemination and Education
• Education alone is not enough • Knowledge and information • Training	• Meetings with employees to discuss BIM technology • Knowledge fostering through social media and brochures • Providing free training for employees	Managerial tactics at work to facilitate change

asserted that this education could enhance awareness, desire and most importantly ability of engineers, designers and contractors to adopt BIM.

3.2 Theme 2: managerial tactics at work to facilitate change

This theme concentrates on the role that can be played by managers in construction projects in facilitating the change towards BIM technology adoption. Interviewees in this theme indicated that while education and previous knowledge of BIM and its offerings for the construction project is vital, it is alone not enough to facilitate the adoption of BIM. They confirmed that project managers should periodically call for meetings with employees to discuss various emerging technologies, including BIM, to further increase their awareness and desire in using the technology. In this regard, a construction project management stated that 'making changes is all about building relationships and trust … I usually keep the same consistent message when my employees hear me talking about BIM and why we should use it in all of our projects'. Furthermore, interviewees explained that one-to-one meetings can sometimes be more powerful in explaining these offerings for employees. A senior contractor affirmed that 'building awareness for the need of change is not enough … there is always a need to build incentives for change and how an employee can benefit if he uses BIM … and this will definitely create desire'. Therefore, a focusing on 'what in it for them' that will make their work better will create their desire. Furthermore, interviewees stated that social media can be employed in this process with employees, in addition to brochures about BIM. However, providing free training for employees through engineers' associations, contractors' unions, and also contracting companies were found by interviewees to be of paramount importance. According to them, training can greatly enhance employees' knowledge and ability to use BIM technology. A construction project manager emphasised that 'we need to see more free training for our employees … we believe that if training is well supported by other parties such as engineers' associations then this will give a clear message to our engineers and employees that BIM is now becoming part of day-to-day tasks and this will ensure that our employees will turn BIM theoretical concepts into reality'.

4. Proposed conceptual model: towards a successful BIM implementation

A conceptual model is suggested to be constructed based on the literature review and the interviews section including the studied thematic analysis. Hence, going deeper inside these provided qualitative data opens the way of how to start the change process towards BIM. In order to change to BIM, ADKAR change management model is needed. All ADKAR components must be studied for different parties including engineering fields. However, if all ADKAR components have to be adopted and one component is adopted well, this will open the next component to be checked consequently. Mostly, the failed component will inhibit the next one to be completed (Lowery 2010). Therefore, to adopt BIM well for engineers, all ADKAR components must be accepted for all fields of the construction projects during the building life cycle. Moreover, the researchers concluded from the qualitative analysis that governmental factors are the main critical factors required to push engineering and contracting companies in addition to the client towards BIM technology adoption.

The proposed model shown in Figure 1 is supposed to be implemented for engineering and contracting companies with different engineering fields, in addition to the clients for successfully ensuring the adoption of BIM with government help. The model is composed of four main parties to be considered by ADKAR: (1) engineers as designers with different specialities including architectural, structural, electrical and mechanical; (2) engineers as contractors; (3) clients as main parties to be involved in BIM adoption with government help; (4) government in order to move construction projects towards BIM by the engineers' association, Contractors Union, ministries and financers as major factors of change. While the first and second groups require working with all ADKAR steps, the third group requires working with only two steps of ADKAR: awareness and desire and the fourth group requires working with three steps of ADKAR: awareness, desire and reinforcement. However,

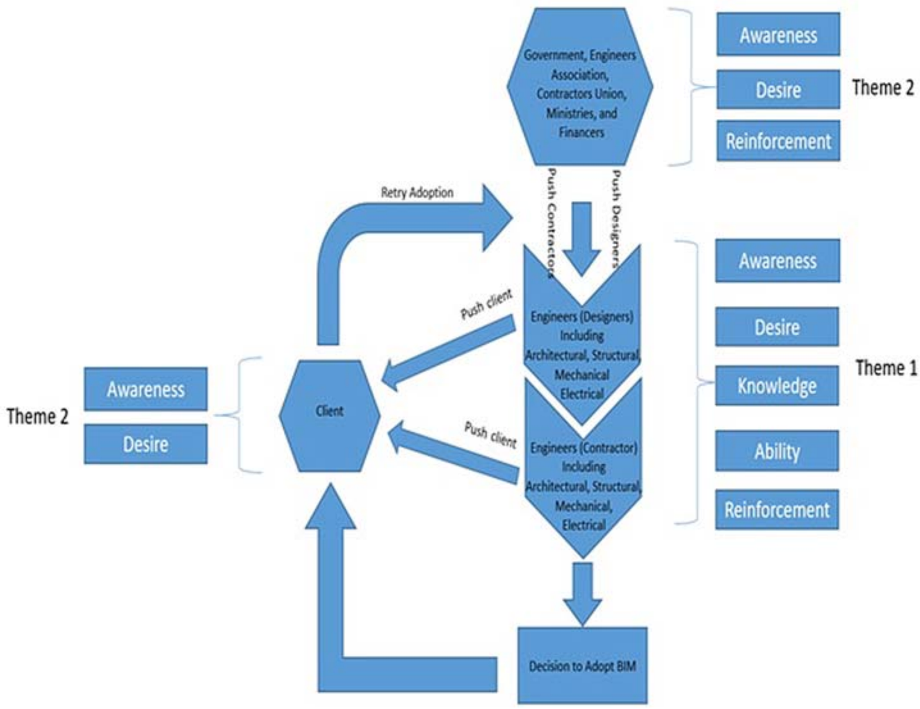

Figure 1. Conceptual model for BIM adoption in construction projects.

determining the level of intervention for different engineering disciplines and other parties need further investigation and beyond the scope of the proposed conceptual model. Therefore, the model will be implemented towards BIM adoption for various fields, as shown in Figure 1, noting that this framework has been judged by arbitrators to verify its validity.

The first element of the framework starts with government, engineers' associations, contractors' unions, ministries and financers as the main contributors to push towards BIM adoption in the construction projects. This group needs awareness and desire to spread the benefits of BIM and its use in construction projects. This includes supporting the projects stakeholders to know what they need to change. Government needs to enforce BIM education and implementation as well as increasing the prices for engineering services. Therefore, engineers request fees for delivering BIM model for projects. Furthermore, impose BIM progressively in law by rejecting traditional working methods. When government is interested in spreading the benefits, education and trainings of BIM for construction projects stakeholders, adoption of BIM will be efficiently increased. Moreover, educational institutions through government could be leaders in pushing fresh graduates and other stakeholders towards BIM adoption (Bin Zakaria et al. 2013). Furthermore, more educational qualification in contemporary educational institutions leads to a better adoption of BIM (Hatem, Abd, and Abbas 2018).

The previous factors will help in converting the traditional system of work in engineering and contracting companies into BIM if they fix their deficiencies and empower their strengths. Engineers either as designer or contractor should work on supporting their ability to overcome traditional engineering methods and change to BIM. Engineers as designers or contractors must work on awareness, desire, knowledge, ability and reinforcement in order to overcome conventional engineering working procedures. Every mentioned ADKAR component level must be improved. Developing the previous level is needed prior to proceeding to the next level. Subsequently, and after controlling all ADKAR component levels for engineering and contracting companies with all their specialities with the help of government, engineers' associations, contractors' unions, ministries and financers as external factors.

The client is the last party in the proposed framework; the client needs to be convinced to accept BIM with all its requirements. The framework concentrates on two ADKAR components for the client. The client needs awareness of the benefits that BIM can bring to their project. Therefore, their desire can be improved and will provide the designer more time without rushing the design office during the work. Furthermore, the client must pay the required fees to develop BIM efficiently. Moreover, the client shall provide the required support to guarantee the success of BIM workflow for all project life cycle.

5. Discussion and practical implications

BIM technology is the latest and most promising technology in the construction industry which is more efficient than traditional and fragmented work activities (Eastman et al. 2011). Furthermore, it helps using the same data by different parties at different times. Therefore, any change can be communicated easily and instantaneously across all disciplines (Ekstrom and Bjornsson 2004). This will enhance the project time and reduce conflicts between parties when it is applied throughout its full life cycle. It will also improve designers work in the design phase in addition to the contractors' implementation during the execution phase. The significance of this research represents mainly in that it is the first topic to discuss the adoption of BIM using ADKAR. The paper aspires showing a prominent shift to move the application from old traditional engineering methods to the modern one throughout the project life cycle. It will then be capable to specify the best direction that BIM system could be implemented in engineering and contracting companies with all their disciplines by using the ADKAR model of change when applying the proposed adoption framework. Moreover, the framework discusses BIM implementation in construction projects with different engineering fields.

After deep searching of literature, and in-depth interviews, several restraints in BIM adoption were noticed. The strengths and weaknesses that prevent BIM adoption were highlighted. Hence, the conceptual model was developed to help in overcoming the obstacles inhibiting the BIM application in construction projects including all stakeholders throughout the project life cycle. The framework facilitates BIM implementation of different engineering fields with various positions for the project life cycle with the goal of BIM adoption. Furthermore, the framework attempts to convince the engineering and contracting companies with all engineering specialities to adopt BIM, then persuade the client to select the new technology with the help of government, engineers' association, contractors' union, ministries and donors. The proposed model considers different ADKAR steps for each of the involved parties. The reason for this is the different role that each party needs to play. The client always focuses on time, cost and quality. Therefore, there is a need to get clients aware about BIM benefits. BIM will provide clients a guarantee to reduce conflicts during construction in addition to eliminating errors and conflicts. It will help clients to be aware of project implementation stages and progress over time. Therefore, clients will be able to follow if his project is implemented on plan in addition to get a more realistic cost estimation. Based on this, clients desire will be increased and, thus, their support to BIM adoption will be in the same as other parties included in the model. This is compatible with the work of Aranda-Mena et al. (2009) who found that BIM enhances the confidence of clients in architectural design outcomes and improves clients' satisfaction level. However, results confirmed that there is no need to consider other ADKAR steps for the client. This is due to the fact that clients are not required to utilise BIM technical knowledge or build application skills abilities.

The model considers that government needs awareness, desire and reinforcement for BIM adoption. After getting government, including engineers' association and contractors' unions, aware of the BIM importance and build their desire, there is a need to keep reinforcement to encourage the individuals to keep going. This could be supported by linking BIM with urban planning in municipalities and enforcing using BIM in formal licence. Government through engineering councils and contractors' unions should force pushing engineers to adopt BIM. This can be realised by driving the engineering firms to supervise projects with all their specialities. Each field must have its private contracts for design and supervision services for all project's stages. According to the results, the need to increase the government knowledge and ability to use BIM is not important for this group as it is the responsibility of engineering firms to offer training for their engineers that can equip them with the right level of knowledge and ability to use BIM technology. Furthermore, results confirmed that government role is most effective in supporting the dissemination of knowledge about BIM benefits and desire to adopt it through devising clear policies for its inclusion in education curriculum for engineers and designers.

All five ADKAR steps were implemented for all the engineers (i.e. designers and contractors) in the developed model. These five ADKAR steps are needed to support these engineers' ability to overcome traditional engineering methods and change to BIM. Therefore, all ADKAR steps are of the same importance for this party. Those engineers who are reluctant to support BIM adoption need to know the importance of changing their traditional working methods to adopt BIM. This can be done by providing them with success stories and real cases for the benefits that was gained through BIM utilisation. In this regard, they would benefit from joining training courses to further develop awareness, desire, knowledge and abilities necessary for BIM application. However, the need to enhance all five dimensions of ADKAR for both types of engineers (i.e. designers and contractors) at the same time was supported by the work of Berwald's (2008) who found that capacity building for various design engineers and contractors during BIM adoption process should be considered concurrently. According to Berwald (2008), this can enhance collaboration between various engineers to support BIM successful implementation. This was also supported by Eadie et al. (2013) who stated that inadequate consideration of change needs of various construction project engineers is a major reason for BIM adoption failure. Moreover, the model suggests that engineers (i.e. designers and contractors) need to maintain a continuous education process to keep themselves up to date with any BIM technology advances for best projects' execution outcomes. It is as explained by Rokooei (2015), BIM adoption needs high knowledge and experience of all engineers involved in the construction project, and that BIM knowledge should always be up to date. However, determining the interactions required by each group of engineers based on their gender, education degree, field of study, years of experience, current position either designer or contractor and size of companies needs to be studied further based on ADKAR steps.

6. Conclusions and future research directions

To conclude, this paper aimed at exploring how BIM technology could be adopted in the construction projects using the ADKAR model of change management. The paper contributes to the literature through the development of an integrated conceptual model of change management for successful adoption of BIM technology. Furthermore, it shows how to manage the different steps of ADKAR to direct the process of change considering different parties involved in construction projects. However, this research has some limitations that indicate various directions for future research. First, findings reported in this study might lack empirical generalisability to other construction industries in other countries; as qualitative data collected here came only from a single-country context (i.e. the Palestinian construction industry). Therefore, future studies may seek to replicate this study using data from other construction industries in other countries to improve the generalisability of results. Second, to the best of the researchers' knowledge, previous studies linking BIM technology implementation and ADKAR model for change management are absent. This has limited the ability of this study's findings to propose grounded theory development. Considering this, future studies are needed to conduct longitudinal studies that can capture quantitative changes to BIM implementation in terms of the rate of successful projects and profitability as a result of the utilisation of the ADKAR model of change management. Third, although this study is using a sample size of eight interviewees that is recommended by McCracken (1988) as adequate for producing perceptive themes from in-depth interviews, this sample size may limit the power of the findings reported. Therefore, future studies should test our conceptual model for BIM adoption by using a larger sample size of interviewees.

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Disclosure statement

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

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