Developments in the Built Environment 3 (2020) 100016

Contents lists available at ScienceDirect

Developments in the Built Environment

journal homepage: www.editorialmanager.com/dibe/default.aspx

Big data innovation and diffusion in projects teams: Towards a conflict prevention culture

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ARTICLE INFO

Keywords:
Conflict
Diffusion of big data innovation
Project teams
Project-based organisations
Critical success factors
Conflict prevention
Culture

ABSTRACT

Despite the enormous literature on how team conflicts can be managed and resolved, this study diverges, by examining factors that facilitate conflict prevention culture in project teams, especially when introducing Big Data Technology. Relying on findings from relevant literatures and focus group discussions, 28 attributes for embedding conflict prevention culture were identified and put together in questionnaire survey. Series of statistical tests including reliability analysis and exploratory factor-analysis. The results identified five critical success factors for entrenching the culture of conflict prevention in project teams introducing big data driving innovations. The five-factor solution include "building effective relationship", "effective project communications", "project team efficacy", "pro-active conflict management approach" and "effectual project documentation". Result of this study presents a Conceptual framework for effective management of human resource in relation to conflict prevention among project teams, as an effective strategy for facilitating seamless adoption and diffusion of big data innovation in organisations.

1. Introduction

Implementing big data technology in projects such as construction is about data-driven decision making to make the entire project delivery process efficient and effective. However, introducing such frontier technology can be confronted with huge resistance and conflicts, especially where organisational culture and structure is closed-ended, with limited open sharing of information (Duffield and Whitty, 2015). According to Buvik and Rolfsen (2015), the critical role of project teams when deploying innovative technologies as part of the delivery process requires insight and careful consideration. Numerous existing studies such as Shazi et al. (2015), Shenhar et al. (2016), Khedhaouria and Jamal (2015) and Zhang and Huo (2015) have reported diverse challenges associated with introducing new technologies within project teams; including disruption in patterns of behaviours and team dynamics (Teece and Leih, 2016), misconception due to misinformation (Mousa, 2015), deviant behaviour (Wong et al., 1999), reduced performance (Lim and Loosemore, 2017), and sabotage (Vrhovec et al., 2015) among others. These various forms of resistance usually result in conflicts within teams, thus leading to far-reaching impact on project outcomes, commitment, trust, and performance (Chen et al., 2017). Highlighting the financial impact of conflict within teams, a US-based study commissioned by the CPP Inc., suggested that, an average of $359billion in paid hours or the equivalent 385million working days, was lost to staff conflicts in 2008 alone (Robyn Short, 2016). Despite its' impact and significance on construction productivity, there is currently no literature as we speak, on conflict prevention culture as a critical strategy for facilitating better diffusion of big data innovation within construction project teams.

1.1. Background

Although conflict has differing meanings. A simple definition from the Oxford Advanced Dictionary describes conflict as a disagreement, argument or a state of mind, in which an individual experience a clash of opposing feelings, opinions, values or interests. According to Vrhovec et al. (2015), conflicts within organisations or project teams can arise due to opposing aspirations or as a pre-meditated resistance from employees, to create barriers that ensure maintenance of status quo (Suprun and Stewart, 2015). Le Roy and Fernandez (2015) and Zhang and He (2016) refer to a project team as a multi-disciplinary work unit whose members

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https://doi.org/10.1016/j.dibe.2020.100016
Received 11 January 2020; Received in revised form 7 June 2020; Accepted 7 June 2020
Available online 22 June 2020

and skills are drawn from diverse functional departments; and is constituted with clear objectives to execute a temporary but unique task in inline pre-agreed set of outcomes. According to Hsu et al. (2016), most project teams often comprise members whose objectives, aspirations and work ethics differ, thus making their seamless interaction and inter-relationship a usually complicated matter. In a recent study by Hueske and Guenther (2015), one of the major concerns within project teams, particularly when introducing innovative technology is the uncertainty of what the new technology means for the team members. König and Neumayr (2017) attributed this concern to the fear of loss. As argued by Shenhar et al. (2016), technological change within established teams can be viewed as intimidating; and a threat to existing skills and competencies of team members. Doppelt (2017) portrayed such resistance as cultural or operational inertia, describing the culture or tendency for a team to remain on its current path and to maintain the status quo.

The construction sector, which is famously known for its age-long apathy for digital innovation (Bilal et al., 2016), is characterised by key professionals such as project managers, architects, engineers, quantity surveyors, etc., all working on every construction project. They are often drawn from different organisations to form a project team, consisting of persons with complex set of interrelated relationships (Owolabi et al., 2018). Each has different objectives, which, in turn, define their approach to work and the relationship they have with the other project participants. They compete for influence and resources and possess different opinions, priorities and goals (Lim and Loosemore, 2017). More so, the potential for risk and unforeseen events in projects, coupled with the significant investments and low-profit margins, often induce a high degree of uncertainty and tension among project teams. All these eventually result into conflicts among project teams (Cheung and Yiu, 2009). In addition to the above contextual challenges, adoption of Big Data technology, which thrives on breaking down organisational and information silos across various competing subdivisions (Owolabi et al., 2018); may also inadvertently be caught-up in organisational power play, information hoarding or control, thereby intensifying conflicts which threatens its diffusion.

Owolabi et al. (2018) refer to Big Data are massively large-dataset, which can be analysed computationally to uncover hidden patterns, unknown correlations, trends, or preferences. Characteristically, Big Data has five vital attributes, also referred to as the 5Vs, which distinguish it from a traditional dataset. These comprise volume, variety, velocity, veracity & value (Bilal et al., 2016). These 5Vs are apparent in most construction & engineering projects data in recent times. According to Bilal et al. (2016), construction and engineering (C&E) projects of today now accumulate a vast amount of valuable data sets right from conception till the delivery stage. Majority of these data are electronic in nature and in diverse formats including [multidimensional (n-D), computer-aided design (CAD) data, three-dimensional (3-D) geometric encoded data, graphical data, video, audio, text, etc.]and sizes (terabytes, petabytes etc.). This thus makes large-scale and advance processing of project data with Big data technologies a necessity (Alaka et al., 2019). Instructively the application of big data in construction project teams is wide-ranging. As widely known, the planning and delivery of construction projects rely heavily on documentation, thus providing a huge opportunity for data analytics. Existing applications of big data on construction projects include cost and time analytics as well as prediction, risk detection & management, quality benchmarking and evaluation, real-time project activity-tracking and analytics, energy use modelling, among others (Bilal et al., 2016; Ahmed et al., 2017; Owolabi et al., 2018). In addition, with a unique capability to capture passive and active datasets vis-à-vis uncovering underlying patterns and insights from datasets, big data analytics can analyse and make predictions using a whole range of project team data (Alaka et al., 2019). Currently, robust analytics can now be used to capture and understand team members' experience of working on past and current projects, work experience in past organisations, skills and competencies, training, education, performance evaluation, attrition in teams, team selection, team mix, leadership competencies and achievements (Han and Golparvar-Fard, 2017). While this crucial information and many more, can easily be analysed to make critical project decisions; there is also the considerable potentials to raise employee concerns resulting in conflicts in project teams.

1.2. Knowledge gaps

Despite numerous existing studies on conflict management in construction projects, the majority of the literature in the field has failed to offer critical insights into the diffusion of Big Data innovation within projects teams. For instance, an in-depth review of research has shown that most studies on conflict prevention in construction projects have solely focused on prevention techniques for dealing with project disputes (Yousefi et al., 2010; Teece and Leih, 2016; and Vrhovec et al., 2015), as against entrenching a culture of prevention among employees. Similarly, while there is the retinue of studies on conflicts in construction project teams (Khedhaouria and Jamal, 2015; Zhang and Huo, 2015); these studies have majorly concentrated on project managers' conflict management styles/competencies and the impact on team performance (Shazi et al., 2015; Vrhovec et al., 2015; Shenhar et al., 2016). In addition, several construction studies have investigated factors promoting or hindering technological adoption on projects (i.e. BIM and Lean Construction Approaches). But unfortunately, many of these studies have not examined conflicts that are caused due to technology implementation (Nicolini, 2002; Ruuska and Teigland, 2009; Ahmed et al., 2017), let alone the need for a preventive culture among teams (Zarif, 2017). According to Arora et al. (2016), this shortage of construction literature on conflict prevention culture on the one hand and innovation-induced conflicts, on the other hand, may be attributed to several factors. Firstly, despite the general awareness in construction about change and technological innovation, and how both often generate conflict and resistance among project employees. Little has been done to examine how such innovation-induced disputes may be adequately and proactively prevented before they surface.

Secondly, the predominant approach to construction disputes is usually through conflict resolution, adjudication, arbitration, and litigation (Muller and Turner, 2007; Kwon et al., 2016), especially in contractual disputes. This approach, which has been widely tagged as reactive and costly to manage (Pavlak, 2004; Gerber, 2013); is not suitable for dealing with innovation-induced conflicts, particularly in the context of Big Data Analytics (BDA) adoption (He et al., 2014; Bilal et al., 2016). Apart from the radical nature of Big Data innovation and the associated new technical skills, new processing abilities and new operational procedures that it brings (Owolabi et al., 2018; Alaka et al., 2019). Such innovations often come with immense technical and operational uncertainties, risks and substantial financial investments which might require employees to radically adapt to protect their jobs (Ahmed et al., 2017). Similarly, with the aid of BDA, an immense amount of project team data such as team attrition, team conflict, resolution, leadership skills, past work experience, training, education, performance evaluation reports (Dutta and Bose, 2015); can now be leveraged for strategic decision making through hidden insights gained from data (Owolabi et al., 2018). Such magnitude of change can visibly be uncomfortable to a good number of project employees, who might feel threatened and may lead to resistant behaviours, tension and conflicts (Lee et al., 2013). However, given that emerging technologies like BDA may dominate the construction sector for decades to come, vis-à-vis the considerable investment cost needed to implement such technology. Embedding the culture of preventing such innovation-induced conflicts, as against relying on mere conflict management styles of project managers (Borhani, 2016; Zarif, 2017); remain critical for ensuring big data technology acceptance among frontline project teams.

Based on the above perspectives, this study contributes significantly to the existing body of knowledge on conflict management in construction, by addressing the social challenges associated with the impacts that

disruptive technologies will have on the future of construction. This is essential because, the current AI and Data economy agenda within the UK construction sector, which is eagerly led by the Government (with a pledge of over £250million to fast track the adoption of digital technologies), will only thrive better with much-less conflict-ridden implementation within project teams. As a result, this study harps on the general principle of "prevention is better than cure" and calls on construction practitioners to intensify conflict prevention culture, to avoid the negative impact of conflict on project success (See Fig. 1. Below for Focus of the study).

The overall aim of this study is to examine project teams' critical success factors that can help to prevent conflict occurrence in construction projects, especially when introducing big data technology.

The study objectives include:

1. Identification of conflict prevention attributes that characterise the operating culture of project teams
2. Exploration of underlying factors that facilitate conflict prevention culture within project teams.

The next section of the study presents a review of extant Innovation theories and diffusion strategies, differences between conflicts and disputes, including attributes of conflict prevention culture. This is then followed by section three presents the methodological approach to the study. Whilst section four presents the quantitative and qualitative analysis of data section. Section Four presents the discussions of the findings and implication for practice and the last section presents the conclusion of the study.

2. Innovation and diffusion within construction sector

The theory of 'innovation' is diversely understood by stakeholders, and its meaning is often strongly contested. However, within the construction sector, Slaughter (1998) gave a widely accepted definition of innovation, which most academics and practitioners align with. According to Slaughter (pp.226), "Innovation is the actual use of a nontrivial change and improvement in a process, product or system, that is novel to the institution developing the change". In another related literature, Drucker (1993) refers to innovation as the use of knowledge to obtain new knowledge. The idea of innovation in the construction industry can take different forms as suggested by Blayse and Manley (2004). Slaughter (1998) categorises such innovation into five different perspectives, based on (1) the extent of change the innovation offers from existing state-of-the-art and, (2) the associated linkages between the new innovation and existing components. The five theoretical spectrums include (1) Incremental and (2) Radical Innovation, (3) System Innovation, (4) Modular and (5) Architectural Innovation.

Whilst incremental innovation is considered a small change from existing status quo, derived from existing knowledge and experience (Nagy et al., 2016); radical innovation is viewed as a ground-breaking innovation that usually changes the nature and atmosphere of the industry. For instance, the use of full-body safety kits by construction workers on sites may be viewed as incremental in nature. But the introduction of Building Information Modelling (BIM) apparently changed the industry's approach to construction processes, from design to delivery including facility management. Regarding system innovation, Ceschin and Gaziulusoy (2016) refers to it as the integration of many autonomous innovations which must work together, in order to implement new tasks or improve operational performance of existing systems. Such innovations come from diverse sources and are clearly connected and integrated to work effectively (Slaughter, 1998). However, while modular innovation describes a significant change within the concept of an existing component without changing the links to other existing components (Chou et al., 2016), architectural innovation involves a significant change to links connecting other components, with minor change within an existing component (Slaughter, 1998). According to Slaughter, all the five innovation frameworks are suited to the unique nature and set of activities performed within the construction sector. In addition, owing to its characteristics, purpose, strategy and requirements, Big Data technology can be said to be a form of radical/-disruptive innovation.

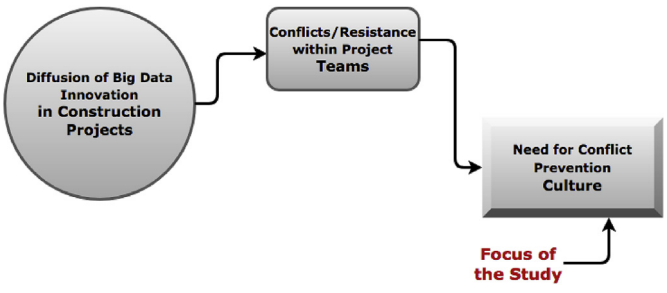

Fig. 1. Graphical Illustration of the focus of the study.

As widely known, low-uptake of digital innovation is a well-documented phenomenon within the construction literature and continues to be a major challenge, even as the industry faces explosion of new innovative construction technologies (Rogers et al., 2015). According to Owolabi et al. (2018), whilst many construction firms attempt to gain the benefits of using of digital technologies, these may be inadequate when only few individuals are adopting such innovation. Diffusion of innovation is therefore a major issue to consider as new digital technologies sweep through the sector. Peansupap and Walker (2005, pp.322) defined diffusion of innovation as "the process in which a new idea, concept or technology has been introduced throughout a social system over a time period". Roger's (1962) ground-breaking research on the diffusion of innovation (DOI) and a host of other theoretical studies – such as Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2016); Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975); Technology Acceptance Model (TAM) (Davis et al., 1989); and Theory of Planned Behaviour (TPB) (Ajzen, 1991) - have all been used to explain how organisations or groups come to adopt new technological innovation.

However, despite the impressive works of earlier studies on how technology can diffuse; emerging dialectical studies on innovation implementation have challenged the diffusion perspective as being pro-innovation biased (Nardelli, 2017; Hargrave et al., 2017). Many authors bemoan the traditional narrative of innovation diffusion as it fails to deeply explore rationales why innovation may be rejected or resisted by users (Heidenreich and Handrich, 2015; Rosenberg and Vogelman-Natan, 2018). For dialectical researchers, research into diffusion of innovation is very vital for understanding how barriers to technology transfer (like conflict and resistance) can hinder successful technology implementation (Bledow et al., 2009; Hargrave et al., 2017; Heidenreich and Handrich, 2015). According to researchers like McAdam (2005), Heidenreich and Handrich (2015), Nardelli (2017) and Hargrave et al. (2017), conflict plays a central role when implementing new innovation. The study of McAdam (2005) on Multi-level Theory of Innovation Implementation provides this study a suitable lens to examine the nature of conflict and tension that usually characterise organisational, team and individual level interactions when introducing new technology. Fig. 2 below highlight how diffusion may be affected by conflicts during innovation implementation.

According to McAdam (2005), the process of implementing new technology is often very fuzzy, complicated and can be tumultuous, especially in working environments characterised with resource and skills scarcity, lack of flexibility and high-task dependency. This description by McAdam suites the complex nature of construction projects. The construction industry has a reputation for relying on tried and tested techniques, practices, processes and an aversion for state-of-the-art innovation, perhaps due to maintainability, cost and reliability issues (Bilal et al., 2016). The above-highlighted issues may explain in part, the

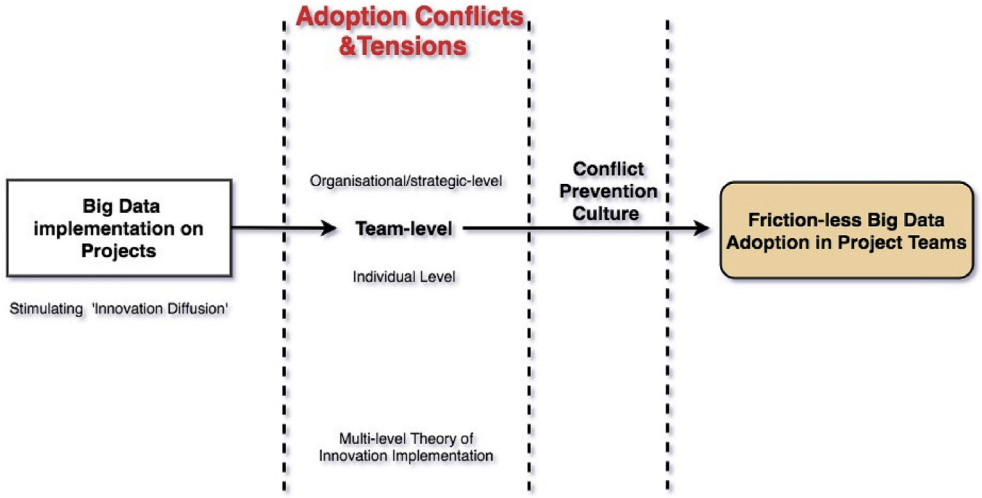

Fig. 2. Big data innovation diffusion & the role of conflict in adoption.

resistance and slow adoption of new technology within the industry (Owolabi et al., 2018). However, according to McAdam (2005), every innovation in an organisation encounters inherent conflicts from employees based on: (1) employees' view of the scale of the change and degree of incompatibilities with existing norms, routines and practices, and (2) employee resistance against the process of creating legitimacy for the incoming technology (social acceptance). As argued by McAdam, these two broad dynamics of conflicts can impact how the entire process of technology implementation.

Nevertheless, as suggested by McAdam (2005), while perceived incompatibilities with innovation remains an inescapable dynamic within organisations and teams, pre-empting conflicts that can be harmful to innovation implementation is necessary for ensuring corporate growth. Hence, this study argues that innovation-induced conflicts can be a clog in the wheel of innovation adoption within project teams and may potentially slow down the adoption rate. As such, where such conflicts have only been managed rather than prevented, enormous negative consequences may abound in terms of adverse effects on projects outcomes i.e. costs, attrition, loss in productivity, etc.

2.1. Differentiating conflict from disputes

Before examining existing literature on conflict management and its associated factors, there is the need to clarify the concept of conflict. The term "conflict is always used interchangeably with "dispute", which normally lead to confusion within the construction industry (Ellis and Baiden, 2008). Conflict and dispute, although similar and resulting from similar sources, are different in definition (Fenn et al., 1997). Conflict can be defined as a disagreement or differences of opinion between two parties, which can become latent or manifest. The complexity of a conflicting issue will become more apparent through neglect to deal with the original issue, consequently leading to disputes. Therefore, one possible outcome of conflict is a dispute (Costintino and Merchant, 1996). Other possible outcomes include, conflict avoidance, capitulation or conciliation. Dispute is therefore a conflicting issue that becomes apparent due to it been neglected or mismanaged when it initially occurred, with one or both parties not contended with its consequences and adamant on getting it resolved. According to Yarn (1999), "a conflict can exist without a dispute, but a dispute cannot exist without a conflict". Conflicts can in some cases, but do not always turn into disputes. They can be worked through to prevent getting to the dispute stage.

It should also be noted that conflict can be 'functional' or 'dysfunctional', having both advantages and disadvantages respectively, but normally is seen to be negative for a project (APM, 2006; Leung et al., 2005; Vaaland, 2004). It can be associated with clashes over differing values and goals, hostility or tension; these differences can affect and impact the projects objectives and performance (Pondy, 1967; APM, 2006). Conflicts can lead to disputes through poor management and lack of competence from those involved (Schneider, 1993; Ellis and Baiden, 2008). A dispute is concerned with an identifiable issue, of a particular, possibly an area of conflict, and tries to identify the cause whilst using procedures to resolve it. Conflict can also be seen as being functional, also known as constructive conflict (Ohlendorf, 2001). This is when conflict is managed correctly, in order to ensure understandings and issues are resolved, whilst having a beneficial impact on the project. This can be through creating 'healthy' competition, opening up the project team to a collaborative approach, challenging ideas and approaches used, whilst also compelling those involved to deal with possible defects, resulting in a better end result (APM, 2006; Ellis and Baiden, 2008; Ohlendorf, 2001; Vaaland, 2004). Within the context of this paper, the focus is on preventing dysfunctional type of conflict arising within project teams.

2.2. Attributes of conflict prevention culture

Many reasons have been offered as the causes of conflict in construction. Cheung and Chuah (1999) conclude that the reasons for conflict in construction project teams are differences in perceptions, priorities and goals rather than differences in the levels of technical understanding or in the management approach adopted. This was corroborated by Desivilya and Eizen (2005), who highlighted that team conflicts stems from diverse points of view, diverse outlooks and diverse interests. This would suggest that a key strategy for preventing conflict is to ensure that all stakeholders share the same project perceptions, priorities and goals. Good communication and a strong working relationship would ensure that perceptions, priorities and goals are shared. Gardiner and Simmons (1992), Ruuska and Teigland (2009), and Nicolini (2002) have acknowledged that improved communication within project team can be a vital factor in preventing or reducing the impact of conflict. Pre-project meetings and regular meetings during project implementation would enable the project team to co-ordinate, monitor progress and discuss potential problems. This was confirmed by the Association of Project Management (2006), that the best new ideas and practices results from project meetings where debate and discussion relating to differences of opinions and interpretations are resolved.

Effective management of risk can also help in reducing conflict. According to Acharya et al. (2006), the problem of not clearly assigning risk could lead to conflict. This along with untimely identification and improper risk assessment could pose conflicting problems for project

teams. Despite the existence of standard construction contracts, where project risks are distributed among members of the project team, there is always the problem of interpretation of implied terms written into contracts, which often lead to confusion (Ulf, 1995). Different perceptions of obligations within a contract can also lead to dispute (Mills and Skitmore, 1999). All these suggest that clear understanding of contract terms, including roles and obligations, and good contract administration could help to prevent conflict arising within project teams.

The characteristics of a team's approach to conflict can be summarised as either *'co-operative or competitive'* (Wong et al., 1999). A co-operative conflict approach builds upon mutual goals that are orientated toward joint benefit, understanding everyone's views, and incorporation of several positions to form a solution that is good for all (Tjosvold, 1991). On the other hand, a competitive conflict approach assumes that the conflict is a win/lose struggle where a stakeholder attempts to make the team conform to his or her views (Barker et al., 1988). In the UK, over the past decade, partnering within the construction industry has become a more viable option in large scale projects. Much of this is as a result of the UK government reports produced by Latham (1994) and Egan (1998). They sought to bring about a greater emphasis on teamwork, and shared responsibility, and eliminate the element of the 'blame culture'. A qualitative study carried out by Harmon (2003) suggests that the use of partnering could prevent and resolve conflicts. Rahman and Kumaraswamy (2004) also promote the concept of relational contracting as a key component of project success. It brings together the principles of partnering and joint ventures between parties, which harness different organisational cultures and endorse a better risk sharing mechanism. This promotes mutual benefits and co-operation that is seen as a win-win situation. Within the project teams, there must be appropriate project competencies (Barker et al., 1988), feeling of involvement and appreciation (Basu et al., 2002; Robey and Farrow, 1989), commitment of team members (Porter and Lilly, 1993), early intervention in resolving differences (Bercovitch and Langley, 1993), and recognising constructive conflicts (Van de Vliert et al., 1999). All these help team building and shared visions, thus helping to prevent conflict within project teams.

Furthermore, administering conflict as part of the main component of project management strategy has been suggested by Gardiner and Simmons (1995); with Fenn et al. (1997) championing that it should be managed in a similar way to cost, time and quality management. This means that the competency, management and leadership styles of the project manager who is entrusted with the management of project and its delivery team is germane to preventing conflict in project teams. Muller and Turner (2007) highlighted that the selection of a project manager including its leadership style will directly affect the successful management of conflict. Specific job types with differing levels of complexity require project managers with different levels of skills and approaches to management (Muller and Turner, 2010). In this case, personality factors of the project manager are very important and include positive attitude of project manager (Iyer and Jha, 2005), maintaining good relationship among project teams (Ahadize et al., 2008) and effective communication of client expectations to project participants (Toor and Ogunlana, 2008). Other project related attributes that could have a positive effect in preventing conflicts within project teams include, complete and consistency of information, e.g. site information (Kougl, 1990), proper documentation of project agreement (Anson and Jelassi, 1990), precise and accurate estimates/schedule (Vidogah and Ndekugri, 1997), good record keeping (Sheppard and Brown, 1993), proper staff training (Pondy, 1993) and defined project roles (Jones and Deckro, 1993). Kindly see Table 1 above for identified conflict prevention attributes for construction projects teams.

Table 1
Attributes of conflict prevention culture (CPC) in construction project teams.

CPC (No.)	Attributes of Conflict Prevention Culture (CPC) in Constructions Project Teams	Sources
CPC1	*All agreements must be documented and implemented*	Barker et al. (1988), Wong et al. (1999)
CPC2	*Good communication skills are vital to conflict management*	Gardiner and Simmons (1992), Ruuska and Teigland (2009)
CPC3	*Regular meetings are essential to identify potential sources of conflict early*	Association of Project Management (2006)
CPC4	*The client must clearly define their expectations to all parties*	Schneider (1993), Ellis and Baiden (2008)
CPC5	*There is need for complete and consistency of information throughout project duration*	Ulf (1995), Mills and Skitmore (1999)
CPC6	*Resolving issues in a timely and responsive manner*	Teece and Leih (2016), Pelled and Adler (1994)
CPC7	*There must be strong project team leadership*	Latham (1994), Egan (1998)
CPC8	*Good record keeping is essential to prevent conflict development*	Cheung et al. (2002); Harmon (2003);
CPC9	*There must be high competency and positive attitude on the part of the project manager*	Harmon (2003), Fenn et al. (1997)
CPC10	*Professional competency among team members is essential*	Robey and Farrow (1989), Vrhovec et al. (2015)
CPC11	*The project team must be committed and motivated to achieve success*	Costintino and Merchant (1996)
CPC12*	*The project manager must have the ability to convey authority**	Ellis and Baiden (2008), Cheng and Yiu (2009),
CPC13	*Awareness and commitment to project objectives/goals by all members of project team*	Rahman and Kumaraswamy (2004), Zhang and Huo (2015)
CPC14	*Project roles must be well defined*	Ozkalap et al. (2009), Yousefi et al. (2010)
CPC15*	*Availability of feedback/clarification from project consultants throughout project duration**	Duffield and Whitty (2015)
CPC16	*Project estimates and schedules must be precise and accurate*	Khedhaouria and Jamal (2015) and Zhang and Huo (2015)
CPC17	*Team members must adopt a co-operative approach to procedures*	Wong et al. (1999); Tjosvold (1991)
CPC18*	*There must be realistic expectations of project teams capabilities**	Schneider (1993), Egan (1998)
CPC19*	*Easy access to higher authority to resolve disagreements (chain of communication)* *	Leung et al. (2005), Vaaland (2004)
CPC20	*Agreements that benefit all parties equally will help prevent the development of conflict*	Basu et al. (2002), Robey and Farrow (1989)
CPC21	*Proper staff training in team building greatly aids prevention of conflict development*	Shazi et al. (2015), Shenhar et al. (2016),
CPC22	*Constructive conflict needs to be recognised and utilised*	Khedhaouria and Jamal (2015), Zhang and Huo (2015)
CPC23	*Positive friendly working relationships must be developed*	Pelled and Adler (1994), Awakul and Ogunlana (2002)
CPC24	*There must be fair/balanced risk allocation and sharing*	Acharya et al. (2006)
CPC25*	*Being familiar with local customs, culture and work ethics is essential to prevent conflict**	Gardiner and Simmons (1992); Acharya et al. (2006),
CPC26	*There must be a feeling of involvement and appreciation throughout the team*	Shazi et al. (2015), Shenhar et al. (2016),
CPC27*	*Personnel must remain consistent throughout the project**	Peansupap and Walker (2005)
CPC28	*Partnering and long-term arrangements on projects can reduce the level of conflict*	Fenn et al. (1997), Ozkalap et al. (2009)

Note: *Additional attributes identified from focus groups interviews.

3. Methodology

The methodological strategy adopted for this study is a mixed method approach, which helps combine qualitative and quantitative approaches

in a single study. For the qualitative phase of the study, the initial data extracted from literature review was triangulated with focus group interviews with construction professionals. This is in line with studies such as Hussein (2015) and Turner et al. (2017) who suggested triangulating data sources helps increase rigour and intensiveness in qualitative research. As such, whilst the literature review was used to uncover a list of twenty-two (22) attributes of conflict prevention culture in construction project teams, the focus group interviews were used to achieve two key objectives: (1) provide access to a wider range of attributes beyond that were identified in the literature, (2) More so, it provided an opportunity to confirm the validity and practical applicability of the attributes discussed in the literature before been compiled together for questionnaire survey.

Thus, the Focus group discussions helped explore the inter-subjective opinions of participants who experienced the phenomena. According to Carey and Asbury (2016), by allowing participants to build on each other's opinions, multiple perspectives to issues are facilitated, thereby providing a rich data for the researcher.

3.1. Focus group interviews

The focus group interviews provided the opportunity of bringing together actual project team members of real–life constructions projects, with the aim of discussing different ways by which conflicts are prevented from emerging among them during projects. Using the researchers' professional networks within the UK construction industry, real-life construction projects were identified from construction companies and used as case studies. As such, the case study projects, therefore, form the basis of the discussions among the research participants. It is instructive to note that, the choice of focus group interviews in this study, as against individual interviews, was hinged on obtaining deeper insights into group thinking and shared beliefs of project team members (Owolabi et al., 2018). Similarly, the use of focus group also ensured individual participants are able to express their inter-subjectively opinions which further enriched the data collection (Oyedele, 2013a). In all, a total of three (3) focus group discussions were carried out, based on three different projects details provided by the research participants. This focus group discussions were conducted between June, 2018 and November, 2018. Furthermore, a purposive sampling strategy was used to identify information rich participants for the focus group interviews and the case study projects. Purposive sampling method, according to Rahi (2017), is a sampling approach whereby the researcher relies on their own judgement to develop key criteria for selecting participants', based on the suitability of their expertise or close interaction with the research topic. In this study the important criteria for selecting the case study projects and its teams include projects where.

1. The construction organisations have implemented Big Data technologies and are increasingly relying on advanced data-analytics in their processes and past project delivery,
2. Most project team members have been trained to use tools underpinned by Big Data technologies in their project delivery,
3. Team members have no less than two (2) years' experience of working with big data enabling technologies and tools on their projects.
4. All team members commonly understand Big Data Analytics used in their various organisations as: the collection of tools, technologies and analytics reports which draw on large-scale, historical and real-time project datasets and facilitates numerous project decisions, team and site operations.
5. Participants have provided ease of access to carry out data collection through focus groups
6. Where there were no dispute resolution procedures such as adjudication, arbitration, and litigation etc., up to the time of the focus group interview.

The reason for this 6th criterion is that if a dispute resolution procedure has taken place, it means some of the conflicting issues arising from the project and its team have neither been prevented from arising nor managed properly, which eventually led to dispute. Overall, all the participants recruited for this study were confirmed to fulfil the above highlighted selection criteria.

Going further, in order to ensure adequate sample for the interviews, a total of seventeen (17) project team members were interviewed across the three case study projects. These include, five project managers, two architects, two contract mangers, three quantity surveyors, two structural engineers, two site engineer and one site manager/foreman for each project. Examples of studies within the realm of project management that have used purposive sampling method include Akintoye et al. (1998), Owolabi et al. (2018) and Oyedele (2013b). Also, the three selected projects used as case studies include a school project, a retail/commercial complex and a small residential housing estate comprising units of detached and semi-detached buildings in the UK.

All the focus group discussions lasted a total of 459mins in duration. The discussions were taped recorded and later transcribed. During interview transcription and thematic coding, six (6) new additional attributes of conflict prevention culture were uncovered and subsequently combined with existing data (See Coding Scheme in Table 2 below). This resulted in comprehensive list of twenty-eight (28) attributes (See Table .1 above for asterisked (**) attributes). In addition, the participants confirmed the relevance of all the remaining 22 identified attributes from the literature. Finally, all the identified attributes were used to develop questionnaire for survey to wider audiences of construction practitioners.

Table 2
Sample of Classification based on the Coding Scheme from Focus Group Discussions.

No.	Quotation	Source	Theme Context	Theme category
1.	*"In most cases, what works better is to have a* ***feedback medium*** *where all parties on the project can express their views on issues … ….and that must happen through the duration of the project".*	Discussant 4	*Availability of feedback/ clarification medium*	Two-way effective communication
2.	*"****management have key roles to play*** *on these types of issues and you must be on-top of your game as a manager … …you have to make yourself* ***accessible*** *and be on hand to diffuse tensions. Create a* ***line of communication*** *…. ".*	Discussant 15	Ease of access to the managers for quick resolution	Accessibility and open line of communication
3.	*"Yeah … … … i think one of the first things we had to deal with is* ***the local language and work ethic*** *of these guys … They have a completely different … …. ".*	Discussant 8	Familiarity with the different cultural backgrounds and working approach.	Good understanding of differences in culture and work ethic.
4.	*"You need every team member to follow this mind-set and approaches* ***from beginning to the end*** *… … …. ".*	Discussant 11	Consistency among project personnel	All personnel must stay consistent through the project.

3.2. The questionnaire survey

The second phase of this study adopts a quantitative strategy. In this phase, the 28 identified attributes of conflict prevention culture were put together in a preliminary questionnaire survey. The preliminary questionnaire was used for pilot study where the relevance, complexity, length and layout of the questionnaire were considered. The respondents of the pilot study were five professionals from the UK construction industry and include two project managers, a site manager, an architect and a project engineer. On average they have 11 years' experience in the construction industry. Their comments were used to produce the final questionnaire.

In the final questionnaire, respondents were directed to rate the level of agreement of each factor with regards to facilitating prevention of conflict within project teams. The level of agreement was across five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Using the directories of UK construction industry stakeholders, which include, Royal Institute of Chartered Surveyors (RICS), Chartered Institute of Building (CIOB), Royal Institute of British Architects (RIBA), Association of Project Mangers (APM), Institution of Civil Engineers (ICE), Institution of Structural Engineers (IStructE), Chartered Institute of Building Service Engineers (CIBSE) and Association of Consulting Engineers (ACE), a total of 200 professionals were randomly selected. Questionnaires were sent to them mostly via e-mail, and by post for those that could not be contacted via e-mail. This took place over a period of 5-months between January, 2019 and May, 2019. In all, 117 questionnaires were returned, representing a response rate of 58.5%. Of these, four questionnaires were incomplete and were therefore discarded, leaving only 113 useful questionnaires for analysis (56.5%). From the 113 responses, 23.9%, 25.7%, 23%, 10.6%, 4.4%, 7.1% and 5.3% are from architectural, civil engineering, building contracting, client, mechanical and electrical, project management and structural engineering organisations respectively. On average they have 13 years of experience in the construction industry and have handled more than 15 projects on average in the last five years.

3.3. Statistical analysis of data

The first statistical analysis embarked on was to evaluate Construct Reliability of the measurement variables through Cronbach's α reliability test. This was important in order to ensure that the data being used for analysis truly measures the construct it was intended to measure (Oyedele, 2013a). In achieving this, SPSS Version 22 was used to check whether all 28 factors were contributing to the construct and therefore were reliable for analysis. The Cronbach's Alpha reliability coefficient produced for the 28 factors is 0.907 (see Table 3 for Results of Reliability Analysis). According to Field (2005), a high reliability coefficient usually of 0.7 and above confirms greater internal consistency of the entire data to measure the construct it was aimed to statistically measure. Konanahalli and Oyedele (2016) suggest that any factor that is not contributing to the internal consistency of the data will have a higher reliability score than the Cronbach's alpha overall reliability coefficient (i.e. in this study, it is 0.907). Such factor if deleted will improve the overall reliability of the entire dataset (Field, 2005). Based on this rule, one-factor that is not contributing to conflict prevent culture was removed from the list of factors due to having *"Cronbach's alpha if item deleted"* that is higher than the overall Cronbach's alpha of 0.907 (see Table 3 Column 4). The affected factor is: CPC27 = *Personnel must remain consistent throughout the project.* The factor recorded a Cronbach's α if Item deleted coefficient of 0.921. The removal of the factor automatically improved the Cronbach's alpha coefficient of the entire dataset.

Additionally, in line with the objective of the study, an Exploratory Factor Analysis (EFA) was carried out to identify the underlying dimensions (factor structure) of the 28 attributes identified in the literature and focus group interviews. This would help to reduce the whole data set to a small number of latent variables, thus removing redundant (highly

Table 3
Attributes of conflict prevention culture.

No	Attributes of Conflict Prevention Culture Overall Cronbach's alpha = 0.907	Corrected Item: total correction	Cronbach's α if item deleted
1	*All agreements must be documented and implemented*	0.415	0.905
2	*Good communication skills are vital to conflict management*	0.468	0.903
3	*Regular meetings are essential to identify potential sources of conflict early*	0.450	0.907
4	*The client must clearly define their expectations to all parties*	0.404	0.906
5	*There is need for complete and consistency of information throughout project duration*	0.562	0.904
6	*Resolving issues in a timely and responsive manner*	0.256	0.901
7	*There must be strong project team leadership*	0.567	0.901
8	*Good record keeping is essential to prevent conflict development*	0.437	0.903
9	*There must be high competency and positive attitude on the part of the project manager*	0.429	0.904
10	*Professional competency among team members is essential*	0.685	0.905
11	*The project team must be committed and motivated to achieve success*	0.391	0.887
12	*The project manager must have the ability to convey authority*	0.571	0.906
13	*Awareness and commitment to project objectives/goals by all members of project team*	0.546	0.902
14	*Project roles must be well defined*	0.540	0.902
15	*Availability of feedback/clarification from project consultants throughout project duration*	0.575	0.905
16	*Project estimates and schedules must be precise and accurate*	0.352	0.886
17	*Team members must adopt a co-operative approach to procedures*	0.562	0.901
18	*There must be realistic expectations of project teams capabilities*	0.515	0.902
19	*Easy access to higher authority to resolve disagreements (chain of communication)*	0.528	0.902
20	*Agreements that benefit all parties equally will help prevent the development of conflict*	0.615	0.903
21	*Proper staff training in team building greatly aids prevention of conflict development*	0.589	0.900
22	*Constructive conflict needs to be recognised and utilised*	0.602	0.900
23	*Positive friendly working relationships must be developed*	0.539	0.901
24	*There must be fair/balanced risk allocation and sharing*	0.379	0.904
25	*Being familiar with local customs, culture and work ethics is essential to prevent conflict*	0.317	0.904
26	*There must be a feeling of involvement and appreciation throughout the team*	0.468	0.903
27	***Personnel must remain consistent throughout the project***	0.352	0.921*
28	*Partnering and long-term arrangements on projects can reduce the level of conflict*	0.492	0.889
	Values with (*) depicts predictors deleted from the list based on Cronbach's α if Item deleted.		

correlated) variables from the data set; at the same time retaining the original information as much as possible. An exploratory factor analysis (EFA) was used as compared to confirmatory factor analysis due to lack of priori knowledge of the factor structure. The EFA was conducted using the SPSS. Before the extraction of factors, the aptness of the data set for factor analysis was examined using three common suitability tests (Field, 2005). These include Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, the Bartlett's test of sphericity and the determinant of coefficient matrix. For this data, a KMO value of 0.73 was achieved which was higher than the minimum value of 0.5 suggested by Tabachnick and Fidell (2001). The Bartlett's test gave a value of $1.35e^{-51}$ which is far lesser than the maximum value of 0.5 suggested by Pallant (2005). The determinant of coefficients matrix indicates a value of 0.00033 (3.3×10^{-4}) which is higher than the minimum value of 0.00001 (1×10^{-5}) recommended by Field (2005). Basically, all these tests confirm that the factor analysis can proceed with the data set. Principal component analysis was used as a means of factor extraction. The orthogonal rotation of factors was carried out using varimax rotation, where factors with Eigen value of equal or greater than 1 were retained. Part of the output of the factor analysis is the scree plot which also suggests the number of factors to be retained. The whole analysis resulted in a five-factor solution giving a total variance of 74.36% as shown in Table 4. They are labelled as:

- Factor Solution 1 represents *"building effective relationships"*,
- Factor Solution 2 represents *"effective project communications"*,
- Factor Solution 3 represents *"project team efficacy"*,
- Factor Solution 4 represents *"pro-active conflict management approach"* and
- Factor Solution 5 represents *"Effectual project documentation"*.

All the five factors are referred to as critical success factors (CSFs) for entrenching conflict prevention culture in construction project teams. The CSFs were subsequently used to develop a conceptual framework for Conflict Prevention Culture in construction Project teams when implementing Big Data Technology (See Fig. 3. Below for Conceptual Framework) (see Fig. 4).

4. Discussion of findings

This section presents an extensive discussion of the findings from exploratory factor analysis and its significance for construction practitioners. This discussion is therefore carried out based on the significance of each factor solution as computed from the factor analysis.

4.1. Building effective relationships (factor 1)

This factor solution accounts for 31.06% of the total variance and comprises of the highest number of constituents among the five-factor solution. They include: "team members must adopt a co-operative approach to procedures", "there must be fair/balanced risk allocation and sharing" "constructive conflict needs to be recognised and utilised", "positive friendly working relationships must be developed", "partnering and long term arrangements on projects can reduce the level of conflict", "there must be a feeling of involvement and appreciation throughout the team", "agreements that benefit all parties equally will help prevent the development of conflict", and "being familiar with local customs, culture and work ethics is essential to prevent conflict". The major overarching principle behind all the eight constituents is about building effective relationships in order to prevent conflict within project teams. This confirms the outcome of Tjosvold and Sun (1993) study which highlights that effective relationships are motivators of conflict prevention within teams. The reality is that if there is a strong relationship within a project team, they would want to maintain it by preventing conflict, which thereby create enabling environment for adopting new innovation being introduced. Leung (1988) acknowledged this by confirming that the

Table 4
Factor Analysis - Extracted Factors and their components.

S/N	Extracted Factors	Eigen Value	% of Variance	Factor Loading
F1	**Building Effective Relationships**	6.315	31.059	
CPC17	Team members must adopt a co-operative approach to procedures			0.855
CPC24	There must be fair/balanced risk allocation and sharing			0.803
CPC22	Constructive conflict needs to be recognised and utilised			0.701
CPC23	Positive friendly working relationships must be developed			0.642
CPC28	Partnering and long-term arrangements on projects can reduce the level of conflict			0.623
CPC26	There must be a feeling of involvement and appreciation throughout the team			0.578
CPC20	Agreements that benefit all parties equally will help prevent the development of conflict			0.543
CPC25	Being familiar with local customs, culture and work ethics is essential to prevent conflict			0.517
CPC17	Team members must adopt a co-operative approach to procedures			0.855
F2	**Effective Project Communications**	2.159	19.173	
CPC2	Good communication skills are vital to conflict management			0.815
CPC5	There is need for complete and consistency of information throughout project duration			0.771
CPC15	Availability of feedback/ clarification from project consultants throughout project duration			0.739
CPC4	The client must clearly define their expectations to all parties			0.635
CPC14	Project roles must be well defined			0.613
CPC13	Awareness and commitment to project objectives/goals by all members of project team			0.567
F3	**Project Team Efficacy**	1.876	9.751	
CPC10	Professional competency among team members is essential			0.801
CPC12	The project manager must have the ability to convey authority			0.687
CPC9	There must be high competency and positive attitude on the part of the project manager			0.632
CPC7	There must be strong project team leadership			0.597
CPC18	There must be realistic expectations of project teams capabilities			0.53
CPC11	The project team must be committed and motivated to achieve success			0.517
F4	**Pro-active Conflict Management Approach**	1.337	7.875	
CPC6	Resolving issues in a timely and responsive manner			
CPC3	Regular meetings are essential to identify potential sources of conflict early			
CPC21	Proper staff training in team building greatly aids prevention of conflict development			
CPC19	Easy access to higher authority to resolve disagreements (chain of communication)			

(*continued on next page*)

Table 4 (*continued*)

S/N	Extracted Factors	Eigen Value	% of Variance	Factor Loading
F5	**Effectual Project Documentation**	1.139	6.497	
CPC8	Good record keeping is essential to prevent conflict development			0.681
CPC16	Project estimates and schedules must be precise and accurate			0.573
CPC1	All agreements must be documented and implemented			0.519

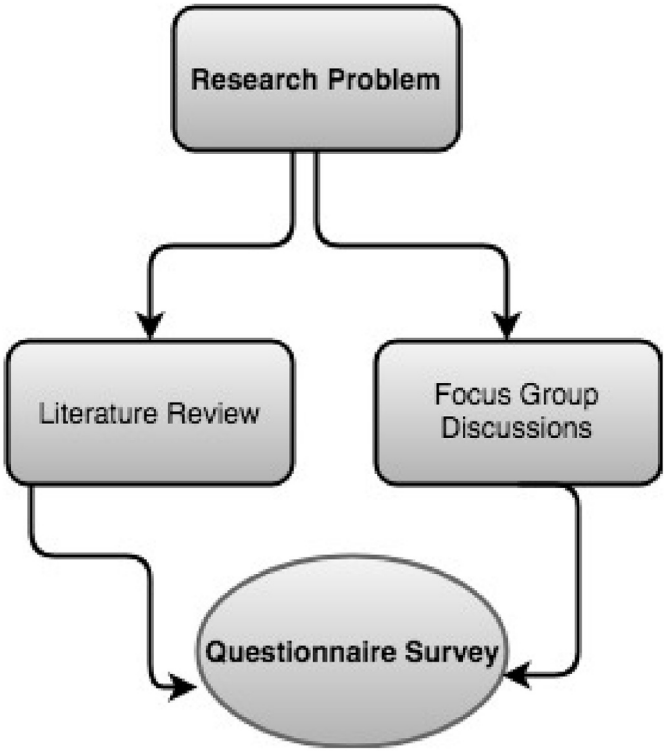

Fig. 3. Research process.

Fig. 4. Conceptual framework - conflict prevention culture for big data adoption and diffusion in construction project teams.

likelihood of pursuing a conflict depends on the relationship between parties. Harmonious relationship would normally propel a friendly atmosphere, which breeds positive reception for new technological innovation, even if there are differences of opinions, priorities and goals within teams that could lead to conflicts. In addition, it also helps to facilitates mutual benefits and co-operation among other things, which are key ingredients for conflict prevention culture.

4.2. *Effective project communications (factor 2)*

The components of this factor which accounted for 19.17% of the total variance include, "good communication skills are vital to conflict management", "there is need for complete and consistency of information throughout project duration", "availability of feedback/clarification from project consultants throughout project duration", "the client must clearly define their expectations to all parties", "project roles must be well defined", "awareness and commitment to project objectives/goals by all members of project team". The main underlying theme of these factors is effective project communication. Mohr and Nevin (1990), and Snyder and Morris (1984), highlighted that communication processes and behaviour underlies most organisational successes and remains an essential requirement when bringing technological changes. In order to ensure better adoption and diffusion of new innovation in project teams, three communication behaviour highlighted by Mohr and Spekman (1994) must exist. These include communication quality, extent of information sharing within teams and participation in planning and goal setting. The quality of information includes aspects such as timeliness, accuracy, adequacy, and credibility of information exchanged (Stohl and Redding, 1987). Information sharing refers to the extent to which critical, often proprietary, information is communicated within team (Huber and Daft, 1987) and; participation refers to the extent to which team engage jointly in planning and goal setting (Dwyer and Oh, 1988) which leads to co-operative efforts. The ability of the project team members to imbibe these three communicating behaviours would enable them to promote actions devoid of conflict and ultimately handle the challenges of innovation adoption in a better manner.

4.3. *Project team efficacy (factor 3)*

This factor represents 9.71% of the total variance in the factor analysis. It constituents include, "professional competency among team members is essential", "the project manager must have the ability to convey authority", "there must be high competency and positive attitude on the part of the project manager", "there must be strong project team leadership, "there must be realistic expectations of project teams' capabilities", and "the project team must be committed and motivated to achieve success". The underlying philosophy of all these factors is labelled as "project team efficacy". It refers to the capacity of the project team to produce the desired effect to achieve project success. In this case, it is more about the competence and commitment of the team to achieve project objectives such as completing the project on time, delivering to required quality and within budget. This enables the entire project team members to work as an integrated team (Egan, 1998), eliminating non-value-added activities (Chan et al., 2000) such as actions that could lead to conflict. From the competency point of view, individual project team members should have the right professional skills to complete project tasks. The same also refers to the project manager, who in addition should be able to demonstrate adequate leadership and convey authority to effectively manage the project. The other part of project efficacy as demonstrated from the results of the factor analysis is commitment of team members. This relates to the strength of an individual's identification with, and involvement in a team. According to Bishop and Scott (2000), it is characterised by (i) a strong belief in, and acceptance of, the team's goals and values; (ii) a willingness to exert considerable effort on behalf of the team; and (iii) a strong desire to maintain membership in the team. All these elements, in addition to the

competence dimension earlier discussed serve as a basis for a high-quality project team efficacy, which would go a long way in helping to prevent conflict within teams.

4.4. Proactive conflict management approach (factor 4)

Components of this factor include, "resolving issues in a timely and responsive manner", "regular meetings are essential to identify potential sources of conflict early", "proper staff training in team building greatly aids prevention of conflict development", "easy access to higher authority to resolve conflicts (chain of communication)". They all accounted for 7.88% of the total variance. Taking a viewpoint that these components point to actions that could curtail conflict development, the underlying factor is labelled as, "proactive conflict management approach". Proactive in this context refers to taking initiative to prevent conflict or minimises the effect of any disagreement that arises within a project team. For example, during project review meetings, individual members can seek feedback about their attitudes towards each other and task assignments to prevent relationship and task conflict respectively. The proactive approach would help to identify sources of conflict and enable the team to deal with them in a timely and responsive manner. In addition, easy access to higher authority within the various organisations or departments that constitute the project team would enable intervention by top management team, particularly where difficulties exist in curtailing the development of the conflict among project team members. The overriding premise is that early intervention will dramatically decrease the risk of the conflict unnecessarily escalating (reducing costs), and increases the prospect of disagreement being resolved to the satisfaction of all parties involved - increasing cooperation (Lazar, 2000; Thompson et al., 2000; Cheung et al., 2002; Harmon, 2003). Behfar et al. (2008) supported this idea by concluding in their study that teams that are successful are likely to be proactive in anticipating the needs that could lead to conflicts among them.

4.5. Effectual project documentation (factor 5)

This is the last of the five critical success factors from the factor analysis characterising conflict prevention culture in project teams with a total variance of 6.5%. It constituents include, "good record keeping is essential to prevent conflict development", "project estimates and schedules must be precise and accurate", and "all agreements must be documented and implemented". The factor solution "effectual project documentation" refers to all documents in relation to successful project planning and implementation and actualisation of any agreement among project team members. The documents could include, project contract, specifications, estimates and schedule of works and programme among other things (Treacy, 1995; Peters, 1984; Fisher, 2003). Existing studies within project management have identified ambiguity and inconsistencies of project documents and lack of written project agreement as key sources of conflict and dispute within project teams (Handy, 1983; Rhys Jones, 1994). In a related study, Andi and Minato (2003) identified 10 relevant attributes of effectual project documentation quality. These include: (i) completeness – documents provide all the information required, (ii) clarity – documents are eligible and are easily read and interpreted, (iii) consistency – documents are consistent (iv) accuracy –documents are free from errors and omissions, (v) standardization – use of standard details in documents, (vi) relevance – document and its details are specific, relevant and appropriate to the project, (vii) timeliness – documents are supplied when required, to prevent delays, (viii) coordination – documents are thoroughly coordinated between project teams, (ix) certainty – documents do not require changes or amendments, and (x) conformity – documents indicate the requirements of performance standards and statutory regulations. With effectual project documentation quality coupled with their implementation, majority of the problems associated with projects contracts and contractual relationships which are normally contained within the project documents will be eliminated, thus preventing related conflicts in project teams.

5. Conclusion and implication for practice

The rationale for and the decision to prevent occurrence of conflict among teams appears to be a fairly logical argument within human resource management, conflict management and project management literatures. However, little guidance exits regarding attributes and factors that characterise conflict prevention culture within project teams, especially when such conflict is induced by the advent of new technological innovation. Majority of the exiting literatures rest on the premise that conflicts are inevitable and can only be managed. Knowing that the associated costs of conflicts can be very high and its consequences being catastrophic to project success as well as the technological investment, this study takes a different approach by identifying factors that can help to prevent occurrence of innovation-induced conflict within project teams. In most cases, the term conflict prevention in conflict management literature has been limited to one of the five styles identified by Blake and Mouton (1964) to resolve or manage conflict (withdrawal – denial/avoidance, smoothing, forcing, compromising and confrontation). This study deviates from such perspectives by arguing for the principle of "prevention is better than cure". It takes conflict prevention from the perspective of preventing conflict from occurrence as compared to managing or smoothing over conflict. It provides an insight into various project practices that would enable achievement of conflict prevention culture and shed light on associated attributes in the context of project-based industry such as construction. This culminates into the emergence of critical success factors including a conceptual framework for facilitating better implementation of big data technology in project teams through entrenching conflict prevention culture.

After a thorough review of extant literatures, associated factors were identified. These were validated with project teams of three different construction projects using focus groups discussions, leading to emergence of 28 attributes. The 28 attributes were put together in a questionnaire survey of various professionals that constitute project teams in UK construction industry. Analysis of collected data includes exploratory factor analysis to identify factor structure and underlying dimensions of the 28 attributes. The results show that five factors which are referred to as critical success factors can help project teams to create a culture of conflict prevention. These include, (1) "building effective relationship", (2) "effective project communications", (3) "project team efficacy", (4) "proactive conflict management approach" and (5) "effectual project documentation".

The above findings have enormous implications for construction organisations and project teams. According to the 2017 KPMG Industry survey, more than 75% of construction and engineering CEOs indicated that emerging technologies such as Big Data Analytics (BDA) is vital to their organisational vision. However, nearly 52.2% of top executives also mentioned barriers like technology resistance, tension and conflicts among mid-level managers and frontline teams, as significant impediments to big data adoption within their organisational settings (New Vantage Partners, 2019). Based on this realisation, this study submits that, to achieve friction-less implementation of radical technologies like BDA among project teams, entrenching the culture of conflict prevention remains vital. This approach, scholars believe, will help reduce uncertainty and tension among frontlines, and also promote technology acceptance (Borhani, 2016; Zarif, 2017); as against seeking dispute resolution. As a result, this study calls on construction project managers to integrate the identified five (5) conflict prevention strategies so as to entrench the culture of conflict prevention within their teams. Construction organisations can also incorporate the identified conflict prevention measures into their overall dispute management framework for ensuring effective technology transfer at project-level. These factors can, therefore, serve as critical success factors for pre-empting innovation-induced disputes, while facilitating conflict-free Big Data implementation within construction projects teams.

Limitation of this study includes focusing the data collection to the UK construction industry. Future studies can investigate the topic in other project-based industries such as aerospace, shipbuilding and telecommunications industries among others that rely heavily on human resources in form of project teams for the delivery of their services. Establishing a process-based model of how these can be effectively put to use in real life projects would go a long way in contributing to knowledge on conflict prevention. This study would serve as the basis for the establishment of wider applicable factors for team operations and dynamics in relation to conflict prevention. Their veracity can be established empirically through a prediction model of conflict prevention in real life projects. This research would help project managers and their organisations to effectively manage their project operations in relation to creating a culture alien to conflict, thus saving huge amount of money and time spend on conflict and dispute resolutions.

Declaration of competing interest

The authors confirm that there are no known conflicts of interest associated with this publication and there has been no financial support for this work that could have influenced its outcome.

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