Master Thesis Research Project

"This is a Paradigm Shift for the entire Industry": Employee Resistance to Technological Innovation in the German AEC Industry

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Abstract

In recent years, the German Architecture, Engineering, and Construction (AEC) industry has experienced a fundamental change towards the adoption of advanced technologies that can be considered as 'disruptive' and challenging for a rather traditional sector. Whilst various studies have already examined the process of adopting and implementing high-tech solutions, they have mainly concentrated on technologies, processes, and policies, disregarding human management. Hence, the objective of this paper is to explore how managers in the German construction industry manage the implementation process of a new technology while also exploring how they deal with employee resistance that occurs throughout the implementation process. For this purpose, 18 semi-structured interviews with AEC companies were conducted and analysed using a combination of the Gioia methodology and thematic analysis. The findings of this study indicate that popular change management models need to be slightly refined in the specific context of introducing a disruptive technology in the AEC sector. More specifically, the findings show that the selection of a guiding coalition, consisting of a change agent and an external consultancy who possess high emotional intelligence (IE) is crucial for the success of the change. Moreover, given the traditional-based industry and the disruptive nature of the technology, a well-designed training is required to motivate and inspire employees for change. With regard to the sources of resistance, generational barriers, functional barriers, and insufficient management support were found to have the strongest impact on employee resistance to technology adoption. In accordance with the identified sources of resistance, empowering and involving employees, as well as the appointment of a change agent with transformational leadership skills and an external consultancy focusing on non-technical skills, emerged as one of the most effective strategies to mitigate resistance. Furthermore, continuous management support and an interactive training approach that focuses on practice rather than theory are critical to overcoming resistance.

Keywords: AEC industry, Building Information Modeling, Change management, Organisational change, Resistance, Technology implementation

"Today, architects, builders and owners are making too many errors by being conservative and clutching to old ways is no longer the best solution". (Jernigan, 2007)

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Abbreviations/Acronyms

2D	Two-Dimensional
3D	Three-Dimensional
AEC	Architecture, Engineering, Construction
BIM	Building Information Modeling
CM	Change Management
EI	Emotional Intelligence
HOAI	Honorarordnung für Architekten und Ingenieure
IFC	Industry Foundation Classes
ICT	Information and Communication Technology
IT	Information Technology
CAD	Computer Aided Design
OCM	Organisational Change Management

1. Introduction

Today's global organisations are characterised by a dynamic environment and rapid technological change (Burnes, 2009; Kotter, 1996; Lindblad & Vass, 2015; Moran & Brightman, 2000). Although the adoption of new technological solutions is steadily increasing across all industries, it is widely recognised that the Architecture, Engineering and Construction (AEC) industry is comparatively slow in adopting new technologies (CII, 2008), which can be explained by the sector's fragmented nature (Dave & Koskela, 2009) and lower productivity (McKinsey Global Institute 2017). Yet, to improve mutual communication processes and counteract the fragmented nature, just like other organisations, AEC companies are forced to permanently adapt to a fast-changing environment to maintain their position in the market.

Among others, within the last couple of years, one new technology that has been mainly and increasingly adopted is the use of Building Information Modelling (BIM) – a digital planning method that is widely considered to be a catalyst for change. Due to different professional backgrounds and theoretical interests, the literature lacks a consistent definition of BIM. In this study, BIM was regarded as an exemplary disruptive technology that generates and manages data throughout the lifecycle of any building project, improving the communication and integration processes between the different disciplines involved in any construction. Therefore, the business process software aims to improve the industry's overall performance while reducing its fragmented nature (Succar, 2009).

Due to the gradual introduction of the new technological solution in German regions, all architects, engineers, and constructors are facing a fundamental industrial change, that will affect several organisations. Consequently, AEC companies are increasingly forced to adapt their organisational processes to technological change, which is associated with various challenges (Maali et al., 2020); in particular, organisations must deal with employee resistance to change. Employee resistance is often the cause of failure in many corporate change programmes (Bovey & Hede, 2001). Waldersee and Griffiths (1996), for example, found in a study that employee resistance was the most frequently cited problem encountered by management in implementing change. Similarly, O'Connor (1993) states that managing resistance from employees is a major challenge for change initiators and is more important than any other aspect of the change process.

Even though approximately 70% of all change initiatives fail (Beer & Nohria, 2000; Grover, 1999), numerous definitions and methods for successful change management (CM) are proposed in the current literature. One of the most popular and well-established approaches to change is Kotter's (1996) eight-step CM model, a holistic method that aims to increase change success by reducing common drawbacks. Recently, Stouten et al. (2018) found scientific evidence for each step and extended Kotter's eight steps to ten steps. As Kotter's model is rather outdated given the study-specific context, Stouten et al.'s extended model was also used to support the theoretical basis of this study.

Considering the reluctance of the AEC industry to adopt technological changes, especially in the German context (Fassauer, 2011) and the complexity associated with managing employee resistance (Aldossari et al., 2021), the main objective of this research was

twofold. First, it was observed how German AEC companies manage the implementation process of a new and disruptive high-tech innovation, in this case BIM. Second, sources of employee resistance as well as appropriate strategies to manage resistance to technology adoption were identified. Hence, the following research question was to be answered in this study:

"How do German construction leaders implement a technological innovation and manage potential employee resistance to change?"

To address this research question, managers and employees of four German AEC companies were interviewed. The resulting data was analysed following an abductive approach that allowed the researchers to rely on existing literature while exploring new factors. The outcomes of the interviews were then compared and interpreted in light of Kotter's well-known CM model and its reinterpretation by Stouten et al. (2018). Both models served as a basis to investigate the implementation process of new technology in the German AEC sector. In addition, resistance to change literature was reviewed (e.g., Ansoff, 1990; Bovey & Hede, 2001; Davis & Songer, 2009; Henderson & Ruikar, 2010; Maurer, 1996; Oreg et al., 2008; Venkatesh & Bala, 2008) and compared to the interview results to further explore the phenomenon of resistance to change.

1.2 Theoretical Contribution

This study aimed to extend the current literature by examining the implementation process of new and disruptive technology (BIM) in the German AEC industry while observing associated employee resistance to technology adoption and providing appropriate management strategies to overcome resistance. There are many studies on Organisational Change Management (OCM), of which Kotter's (1996) model is one of the best known. Meanwhile, there are several extensions, such as the model by Stouten et al. (2018), which is often used by organisations. However, still limited literature exists on OCM practices that provide strategies for effectively managing a change process within the AEC industry (Erdogan et al., 2014, Maali et al., 2020). With regard to the phenomenon of resistance to change, a large body of literature is available, but there is little research on how employees respond to the implementation of new and disruptive technologies in the AEC industry (Aldossari et al., 2021; Davis & Songer, 2002, 2009; Erdogan et al., 2014, Lines et al., 2015). Most research on resistance to change focused on companies outside the construction sector, as, for example, the service sector. In turn, other researchers concentrated on non-technological changes, such as fusions and/or restructuring (Lines et al., 2015). Another obstacle to the limited knowledge of resistance to technological innovation in the ACE industry, is the inconsistency (Gore, 2010). The findings vary across sectors, making it difficult to comprehensively identify the methods that reduce resistance to technological change (Lu et al., 2020).

Therefore, to fill the knowledge gap regarding the implementation of new and

disruptive technology in the German AEC industry, this study aimed at providing a guideline for effective technology implementation and identified sources of employee resistance as well as key strategies to overcome resistant behaviour.

1.3 Practical Contribution

In Autumn 2022, the German government will introduce a new regulation that will force German AEC companies to implement and work with the business process software BIM (Baumanns et al., 2019) to enhance productivity and communication processes within the multidisciplinary sector, which implies radical organisational changes. Consequently, construction managers may use the results of this study as a guide to determine the best steps to adopt a technological innovation as part of organisational change. In addition, the results of this study can provide companies with concrete advice on dealing with sources of employee resistance to change that may occur during the process of introducing top-notch innovations, such as BIM.

This thesis is divided into the following sections. First, based on the central research question, the theoretical framework will explain the most important topics as well as underlying theories that have been explored in previous literature. Second, the methodology, including the research design and the data analysis, is described. Thereafter, the main findings are presented and discussed. Finally, a conclusion, highlighting the most important findings, is given.

2. Theoretical Framework

The following section defines the key concepts of this research and discusses previous work on OCM, including related theories. The central research question serves as the basis for generating the theoretical framework. As OCM in relation to the technological implementation of BIM and associated employee resistance are the core topics of this study, these concepts are further explained within the theoretical framework. Moreover, Kotter's widely known theory of change management as well as its reinterpretation by Stouten et al. (2018) will be discussed.

2.1 General Definition of OCM

In the research field of OCM, there are numerous definitions and various CM models, depending on the context. First, a general overview of definitions will be given to gain first insights into the topic. Shonhe (2017) defines change as a phenomenon that has become indispensable and inevitable in the 21st century, as rapid changes and technological advances have affected the way business is done and how people from all over the world communicate with each other. According to Todnem By (2005) changes and/or adaptions are common in any stage of a project's or organisation's life cycle and can consequently be regarded as an integral part of life. Various authors associate the term change with different kinds of processes. While Beer and Nohria (2000) consider the nature of change as a learning process, Ortenzio (2012) and Borg et al. (2014), for example, define change as a process-driven activity. According to Creasey and Hiatt (2003) altering a traditional work process to improve an organisation can be seen as the primary objective of a change process. Similarly, Burnes (2009) defines OCM as taking action to integrate new processes that differ from the organisation's traditional working practices to realise organisation-wide goals.

Some other authors define OCM slightly differently as they include further areas. According to Moran and Brightman (2000) CM can be considered as "the process of continually renewing an organisation's direction, structure, and capabilities to serve the ever-changing needs of external and internal customers" (p. 66). Consequently, if an organisational change occurs, involved stakeholders, such as employees, business partners, customers, and investors will be affected by the transition process and must be managed accordingly. Similarly, Gover and Duxbury (2012) argue that organisational changes can be viewed as a process in which an organisation is forced to adapt to changes emerging in its surrounding environment. According to Cao et al. (2000) organisational changes include changes to organisational processes, changes in functions, changes in beliefs and values, changes in human behaviour, changes in power distribution, and the way organisational issues are influenced; all changes are interrelated and influence each other. Erdogan et al. (2005) differentiate between internal and external reasons causing changes at the project or organisational level. Due to the reason that this study focuses on changes related to the

introduction of a new technology, the implicit reason for the organisational change can be considered as an external reason. Yet, AEC companies mainly experience internal consequences, meaning changes within the organisation need to be managed accordingly. Internal changes include changes in the organisational structure and culture, changes in the managerial, technical, and psychological system, changes in goals, values as well as in the management philosophy. Therefore, the implementation of BIM can be considered as an external reason causing internal changes in the structure of an organisation.

Jick and Peiperl (2007) divide the term change into three categories. On the one hand, a developmental change can be considered as a continuous, never-ending process; on the other hand, the transitional change lasts for a specific period with the state of transition between the old and new states of an organisation. The third perspective is the transformational change, which implies both developmental and transitional changes. Due to the reason that this study involves the implementation process of a new technology, which implies an old and a new state, the change is considered as a transitional change process.

There is a clear consensus throughout the literature that the pace of change has never been faster than in the current, constantly evolving business environment, which will most likely lead to more employee dissatisfaction (Maali et al., 2020). Given the study-specific context of technological change, the next section focuses on OCM regarding the implementation of a new technology in the AEC industry.

2.2 OCM in relation to Technology Implementation in the AEC Industry

The AEC industry is often being confronted with many changes, which is one of the principal sources of risks in construction. For example, time delays, project cost overruns, disagreements, and subsequent improvements are common risks but also part of the business (Love & Irani, 2004; Mezher & Tawil, 1998). Sun and Vidalakis (2009) state that any construction project is unique in its nature and has an interdisciplinary, interim, and multi-organisational team structure, which is influenced by different site and climatic conditions. Any industry is dependent on specific environmental circumstances or so-called contingencies that must be managed accordingly (Erdogan et al., 2005).

Yet, the AEC industry is known for being slow to embrace changes (CII, 2018; McKinsey Global Institute 2017). Although, there is general consensus that it is better “to plan in advance than to think afterwards” (Sun & Vidalakis, 2009, p. 803) various factors lead to project changes that inevitably involve a high degree of risk. Several frameworks, specific models and IT support systems have been developed to counteract project changes and improve the performance of construction companies. However, to take full advantage of a technological solution, a company must apply effective OCM to facilitate a smooth transition process ensureing that predefined goals are ultimately achieved.

The focus of this research is on CM on the organisational level within the AEC industry. Yet, the literature shows that most studies refer to CM at the project level rather than the organisational level (Erdogan et al., 2005). CM at the organisational level is quite similar to CM

at the project level, however, the actions undertaken are rather changing the organisation's characteristics to adapt to the changing environment. Erdogan et al. (2005) state that organisational level change is related to people, technological issues, management issues and/or cultural matters.

The implementation of a new technology can be considered as an organisational change as the adoption affects various processes and strategies within an entire organisation (Maali et al., 2020). Changes at a project-level are typically associated with negative consequences, however, changes at an organisational level, for example, technology implementations (e.g. virtualisations, simulations, design coordination, error detection programmes, or clash testing) can provide improvements and new opportunities, which can become essential for core business processes in a company (Khosrowshahi & Arayici, 2012).

Nevertheless, introducing a new technological solution is accompanied by various change barriers. Venkatraman et al. (1993) state that changes at several levels are required to adopt an ICT-based business strategy. It may include changes on the administrative structure, including reporting relationships and individual positions, the expression of work processes, and corresponding information flows. Moreover, it is possible that key competencies of employees and other stakeholders need to change and up- or re-skilling of existing staff will be required, meaning construction companies are forced to provide an appropriate training programme for the entire organisation. Current research mainly focused on the functional benefits of a particular technology, ignoring essential OCM aspects, such as structural changes, changes in the work culture, the need for staff involvement, sufficient education and training, appropriate resources, adequate planning, and monitoring and measurement systems (Ansarian, 2014; Maali et al., 2020). Consequently, the introduction of BIM will lead to a technology-based change at the organisational level, affecting management issues, cultural concerns and people in the company (Erdogan et al., 2005). This study focuses particularly on the latter, namely on how employees experience and perceive the implementation process of BIM and associated CM pactices. In the following subchapter, the advantages of the new technological solution BIM are elaborated.

2.2.1 Benefits of Implementing BIM

In the early 2000s BIM was implemented to assist integrated building designs of architects and engineers. Given various benefits during the different phases of design, planning, and construction of new buildings, there had been growing interest of the AEC sector in using the technological artifact BIM (Volk et al., 2014).

Also the German government is shaping the transition to BIM-based working processes. In 2015, Alexander Dobrindt, the German Federal Minister of Transport and Digital Infrastructure, published a comprehensive step-by-step plan for the introduction of the BIM technology, which became compulsory for government-led infrastructure projects in December 2020. As of autumn 2022, the utilisation of the BIM software will be mandatory for all federal constructions in Germany.

Various definitions of BIM can be found in the literature. According to Vanlande et al. (2008) BIM can be considered as a process that generates, manages, stores, exchanges, and shares construction information among all stakeholders throughout the whole life cycle of any building project. Xiaozhi Ma et al. (2018) define BIM as a disruptive information and communication technology in the AEC industry, that facilitates stakeholders to manage a project utilising a model-based cooperative method. BIM is a computer software model that simulates the construction and operation of a building. It can be considered as one of the most promising developments regarding the AEC industry.

In the literature, there are several definitions of adopted technology categories that must be differentiated. Maali et al. (2020) differentiate between three technology functions, namely business-related software, project-related software, and physical technology tools. BIM can be defined as a project-related software as it can be considered as a system that influences tasks and employees at the project-level within an organisation.

Working with the BIM system offers several advantages for the industry. The technology enables a digital construction of a virtual model of a facility and is a useful tool for the three disciplines, architects, engineers, and constructors. It visualises what will be built in a simulated 3D environment, which helps to identify potential design, construction, and/or operational errors. Consequently, the integration of BIM will connect all stakeholders involved in a project while minimising constructional errors (Azhar & Asce, 2011). BIM offers great benefits regarding data integration (Succar, 2009). The use of the BIM technology facilitates innovation in the construction design phase through intelligent data management and the ability to work across disciplines (Selçuk Çıdık et al., 2017). In addition, Jaaron et al. (2021) argue that the utilisation of ICTs, such as BIM, will significantly improve the productivity and mutual communication processes between stakeholders in the AEC industry. Moreover, through the usage of shared design models, not only the communication but also the coordination between all involved parties will be enhanced. The authors further say that BIM will enable users to work with more efficient techniques related to the design and execution phases of construction projects.

As shown, there are several definitions of BIM implying different meanings depending on different backgrounds and experiences of professionals. However, to have a consistent definition of the term, this study considers BIM as a technological solution that generates and manages data throughout the life cycle of a construction project to improve the communication and coordination between all disciplines involved. Thus, by using the business process software BIM, the efficiency will be enhanced while high costs due to insufficient interoperability will be reduced; hence, the overall performance will gradually improve.

Scientists concluded that traditional business processes and strategies must be changed accordingly to benefit from the full potential of BIM. Hence, a proper change management approach may help to facilitate the transition. Several OCM models have been developed to address this issue. One of the best known and most established frameworks is Kotter's eight-step model, which is discussed hereafter.

2.3 Theoretical Approaches in OCM

There is a large body of literature on OCM theories and models which has been examined to gain profound knowledge. Based on a comprehensive review of change literature by Al-Haddad & Kotnour (2015), the models of Lewin (1947), Judson (1991), Jick and Kanter (2005); Kotter (1996), Luecke (2003), and Hamel (2000) were evaluated in light of this study and partly used to interpret the findings. Although many of the models under investigation were similar, Kotter's leading CM model (1996) was found to be most appropriate for studying the implementation of new technology in the AEC industry as it is one of the most famous and proven approaches to OCM; his eight-step OCM model is a holistic method that aims to identify the most common obstacles when implementing change and provides guidance on how to overcome them. Meanwhile, there are several extensions of Kotter's well-established model. Stouten et al. (2018), for example, provided scientific evidence for each of Kotter's steps and extended his eight steps into a ten-step model. Both models are described below, with Stouten's steps simply summarised in a table.

John Kotter (1996) is a well-known thought leader in business, leadership, and change. The scientist suggested that the see-feel-change approach works better as soon as people are involved in the change process or to get people to adopt the introduced changes (Kotter, 2002). The see-feel-change method is a more thorough approach as it focuses more on the emotional level. Making, for example, use of compelling and eye-catching situations to visualise problems will help people to actually "see". These visualisations will lead to catching a person's emotions (feel) which in turn will help to change or sustain the changed behaviour (change). His analysis of 100 different organisations, that were going through change, resulted in an effective eight-step model.

The first stage is about "establishing a sense of urgency", meaning people start telling that a change is needed which leads the people to see and feel the need and importance of the change. The second stage "building a powerful guiding team" should consist of members that are able to guide a big change while working well together. The third action step is to "form a strategic vision" including the development of the right vision and strategy for the change effort created by the guiding team. The fourth step is to "communicate the vision" where people start to adapt to the change which can be recognised by their behaviour. Kotter (1996) even advises communicating the change "at least 10 times the amount you expect to have to communicate" (Cameron & Green, 2015, p.110). The following step is to "empower people to act on the vision" by removing barriers to change; more and more people will be enabled to act and start acting according to the vision. The sixth step is to "generate short-term wins", meaning short-term improvements need to be communicated and advertised while people should be rewarded publicly for their performance. The next step is to sustain the change. Here, people will progressively adapt to the change until the vision will be completely fulfilled. Organisational members who work towards the vision should be encouraged and rewarded and the change process should be stimulated with new resources or projects. Finally, the eighth step is to perpetuate the change, i.e., maintain the new and

desired behaviour of employees regardless of attractive traditional behaviours or resentment of excessive income of leading persons.

Although Kotter's CM model is one of the most popular frameworks, there are some limitations. A significant drawback is, for example, the linearity of the model, which means that a rigid chronological sequence of the eight steps is assumed, and it does not consider iterative processes or moving back and forth between the different phases (Appelbaum et al., 2012). Even though the see-feel-change approach is appropriate when people are involved in the change process, the model is criticised for taking a top-down approach, i.e., it is better suited to larger companies with a traditional hierarchy. The focus is thus placed more on the upper layers of the hierarchy while the lower layers are often neglected. Moreover, Kotter's steps peak early, meaning more emphasis and energy are put into the initial stages while managers do not devote the same amount of energy to the final stages. However, Cameron and Green (2020) experienced that the entire change process is equally difficult, exciting, and challenging, meaning the management should give equal attention to all phases of the process.

As mentioned in the introductory sentence, Stouten et al. (2018) provided scientific evidence for each of Kotter's steps by assessing and synthesising prescriptive writings and scientific studies on the management of planned organisational change. In general, Stouten et al.'s (2018) ten steps can be seen as an extension of Kotter's eight steps, which are summarised in the following table.

Step	Definition
Assess the Opportunity or Problem Motivating the Change	Information from all stakeholders involved need to be gathered, paying particular attention to employees who will be affected by the process of change.
Select and Support a Guiding Change Coalition	A guiding coalition that supervises the change process needs to be formed. The guiding coalition plays a supportive role and provides continuous feedback to the top management. It needs to develop trust with those affected by the change and should use appropriate communication tools (Kotter, 1996). The common goal of the coalition should be to strive for superiority (Kotter, 1996).
Formulate a Clear and Compelling Vision of the Change	A vision must signal separation from the past and contains a compelling expression of the end goal or state (Kanter et al., 1992). It is the translation of an opportunity into practice and should express the explicit goals of the change (Kotter, 1996). A vision must be implementable and easy to communicate to all stakeholders. It must be emotionally engaging and flexible enough to allow alternative actions and/or individual initiatives (Kotter, 1996).
Communicate the Vision	The vision must be communicated thoughtfully to raise awareness (Hiatt, 2006) and support the change (Kotter, 2005). To avoid confusion and employee resistance, the management must be transparent and open in their communication while eliminating inconsistent messages (Kotter, 1996).
Mobilise Energy for Change	The actual implementation of change needs to be planned at different levels of the organisation to mobilise energy for change. Information need to be gathered to plan the change activities, sequencing specific change activities, and introducing key support measures (Hiatt, 2006; Kanter et al., 1992). In this phase, the readiness of the employees for change must be assessed (Hiatt, 2006).
Empower Others to Act	Employees must be empowered to act on the vision, developing new ways of working and ideas that arise from their understanding of change (Judson, 1991; Kanter et al., 1992; Kotter, 2005). Empowerment can either be a form of coaching and supporting employees to manage problems (Hiatt, 2006), but it can also be a

	form of removing obstacles that might prevent employees from participating in the change (Beer, 1980; Kotter, 2005).
Develop and Promote Change-Related Knowledge and Ability	Learning new skills and acquiring sufficient knowledge is a prerequisite for implementing effective change. Employees must understand the vision and form new behaviours motivated by the change (Kotter, 1996 & Hiatt, 2006). Managers must offer support so that employees can act independently and proactively because learning is enhanced when sufficient resources (Hiatt, 2006) and support (Beer, 1980) are provided.
Identify Short-Term Wins and use them as Reinforcement of Change Progress	Clear objectives must be set so that the success of the change is visible for stakeholders (Hiatt, 2006; Kotter, 1996, 2012). Short-term wins can create a fulfilling sense of progress, which can have a positive impact on the desire to achieve long-term goals. However, these short-term goals must be seen as meaningful by employees, otherwise there is a risk that they will be ignored (Kotter, 1996).
Monitor and Strengthen the Change Process over Time	The change process must receive continuous attention. Leadership effort, money and personnel still need to be invested in managing barriers to maintain the pace and constantly remind people of the need for change (Kotter, 2012). Appropriate behaviour must be further encouraged to reinforce the change (Hiatt, 2006). Top management must continue to focus on the change vision, while middle management and staff continue to work on specific projects that require change.
Institutionalise Change in Company Culture, Practices, and Management Succession	The change must be integratged in daily activities and organisational processes (Beer et al., 1980; Kanter et al., 1992; Kotter, 2005, 2012). To manifest the change, it must be actively made clear to employees that the change is the reason for the performance improvement. Explaining the results of the change via different communication channels will support the credibility and legitimacy of the introduced changes.

Table 1: Stouten et al.'s (2018) ten step change management model.

It was decided to use both Kotter's (1996) and Stouten et al.'s (2018) models as theoretical basis for this study. Although Kotter's model is well established and one of the best known models for OCM, it is relatively old and may be less appropriate in technology-driven times. In addition, a drawback of the model is that it tends to follow a top-down approach and takes less account of employees' perspective on change. In the study-specific context of introducing a new and disruptive technology - a rather recent topic – the reinterpretation of Kotter's model by Stouten et al. (2018) was found to be a useful support as the researcher placed greater emphasis on involving employees in the change process (see step five, mobilising energy for change; and step seven, developing and promoting change-related knowledge and ability).

2.4 Reasons for Employee Resistance to Organisational Change

Current CM models present guidelines to help identify and reduce critical barriers that occur throughout a change process. A large body of literature has already identified that employee resistance is one of the major challenges when implementing new technology in the AEC industry (Lawluvy et al., 2022; Henderson & Ruikar, 2010; Liao & Ai Lin Teo, 2018). Maurer (1997) even stated that employee resistance is the primary reason for failure when introducing an organisational change.

Various definitions of resistance can be found in the literature. Lewin (1947) originally defined the term resistance as an active use of an inner force to fight change, which was later, however, conceptualised "as a reactive passive attitude toward the change" (cited in Oreg et al., 2018, p. 66). Yet, this study will focus on an older but more elaborated definition by Ansoff (1990) who defines resistance as a phenomenon that influences the change process, slowing it down, opposing, hindering or stopping its implementation, and raising its costs.

Numerous researchers classified resistance in different ways. Bovey and Hede (2001), for example, identified three categories: resistant versus supportive, passive versus active, and overt versus covert behaviour. Other researchers categorised employee reactions toward organisational change as favourable or unfavourable (Herscovitch & Meyer, 2002) or as positive (e.g., acceptance) and negative (e.g., resistance) responses to a change initiative (Oreg et al., 2019). More specifically, Oreg et al. (2018) distinguished between four emotional episodes (resistance, disengagement, acceptance, and proactivity) in response to change events. While proactivity and acceptance are considered positive responses to change, resistance and disengagement comprise negative responses. Resistance involves a stressed, angry, or upset reaction to a change event; disengagement is characterised by a sad and helpless reaction to change. Among others, reactions include withdrawing behaviour, withholding important information, actively spreading derogatory and critical opinions and information about the change, or even mocking and manipulating the change, and stoking fears (Bovey & Hede, 2001; Oreg et al. 2018).

In the specific context of new technology adoption, Schneider & Sting (2020) identified five different frames that determine an employee's neutral (utilitarian, functional, anthropocentric frame), positive (playful frame) or negative (traditional frame) attitude toward new technology adoption. Since this research only considers negative attitudes towards change events, only the traditional framework is defined. As the term already suggests, employees in this framework, prefer to stick to traditional forms of cooperation and communication. Therefore, they show a rather pragmatic behaviour towards any automation, as individualism in the workplace might be lost and human interaction could be impaired.

In addition, poor management support and lack of commitment have been found to be major reasons for resistance to change (Davis & Songer, 2002; Henderson & Ruikar, 2010; Venkatesh et al., 2003; Zhao et al., 2014). This has significant implications because if leaders are not committed, they may under-invest in the necessary resources, not facilitate the necessary training and show too little communication effort. Furthermore, if change recipients do not trust change agents, or if managers try to push too vigorously, resistance will be further

reinforced (Schulz-Knappe et al., 2019). Other commonly known reasons for resistance have been identified in previous literature, which are also summarised in Table 2 (Luecke, 2003; Håkansson & Ford, 2002).

The natural tendency of individuals to defend the status quo confronts managers with several challenges that must be overcome to successfully implement change. Therefore, leaders must understand the sources of resistance and react accordingly. The next section presents some practices for managing employee resistance that have been identified by previous literature.

Reasons for resisting change	OCM practices to cope with resistance
Emotions, such as stress, anger, grief, sadness, helplessness, fears of the unknown	Managers with high EI
Wish for traditional forms of cooperation and communication	Transformational leadership style
Lack of commitment of board and senior managers	Suffcient management support and transparent communication
Lack of information, knowledge, low perceived usefulness	Comprehensive change-related information
Too less training, too little communication effort	Clear and sufficient communication about the change
No trust in change agents	Effective change agents
Fear of failure, lack of skills	Adequate change-related training and education
Threats to status/loss of power	Employee empowerment
Lack of perceived rewards	Providing necessary resources (e.g., time, money)
Uncertainty regarding change outcomes	Incentive systems
Lack of involvement	Employee participation in the change process

Table 2: List of reasons for resisting change and corresponding OCM practices.

2.4.1 OCM Practices in relation to Employee Resistance to Change

In the literature, several OCM practices can be found that aim at reducing employee resistance to organisational change. Table 2 summarises various OCM practices that have been found useful in the literature for dealing with resistance to technological change.

According to Hiatt and Creasey (2012), people must be considered as the starting point when introducing change actions. Hiatt further defines CM as an integral set of processes and methods to manage human resources successfully during the entire organisational transition project. Several researchers (Davis & Songer, 2002; Erdogan et al., 2008; Henderson & Ruika, 2010, Venkatesh & Bala, 2008) found that extensive change-related training, education and communication belong to the most important strategies to mitigate resistance to change when implementing a technology. Henderson and Ruikar (2010) stated, for example, that organisational members need to be thoroughly trained and educated before any change initiative is implemented to be well-prepared. In their study, Wanberg and Banas (2000) found a positive relationship between the amount of information attained about an organisational change and employees' willingness to change events. Similarly, Bourne et al. (2002) argue that

employees must be given clear information about the benefits that will be generated by the change; otherwise, employees will feel stressed, leading them to resist change because they are uncertain about the outcomes and how to complete their jobs appropriately.

Furthermore, it is stated that employee participation will reduce resistance to change (Burnes, 2015; Davis & Songer, 2009; Henderson & Ruikar 2010; Venkatesh & Bala, 2008). Staff working at the lowest level of an organisation's hierarchy are least likely to be involved in the implementation process; yet they are most likely to be affected by the organisational change (Henderson & Ruikar, 2010; Lines et al., 2016). Schweiger et al. (2018) found that employee participation will reduce resistance by raising awareness of the need for change.

Moreover, it has been found that employee resistance decreases when sufficient management support is given (Davis & Songer, 2002; Erdogan et al., 2008; Henderson & Ruikar, 2010; Oreg et al., 2019; Venkatesh & Bala, 2008). Therefore, leaders must be committed to and support the change initiative by participating in the change process. Hence, managers must ensure that employees can contribute to the change by giving input; this input needs to be valued by managers to create appreciation and the feeling of being an important part of the change. Related to this, Oreg et al. (2019) identified that social support (management support and transparent communication) can raise an individual's self-esteem, increases a change recipient's perceived amount of control and decreases their stress level.

In addition, Lines et al. (2015; 2016) identified that change agents are significant to overcome staff resistance to change by demonstrating the advantages and urgency of change. The researchers found that AEC companies that appointed a change agent who is responsible for a smooth implementation process faced less resistance than organisations that did not designate a change agent. It is crucial that change agents build a positive work relationship with employees who are responsible for implementing the changes.

Moreover, several studies have found that a leader who possesses high emotional intelligence (EI) can increase the performance of assembly line workers (Wong and Law, 2002; Zeidner et al., 2004) while also enhancing employee creativity (Rego et al., 2007). Furthermore, studies show that managers with high social competence are more likely to recognise their employees' willingness to change and innovate (Zeidner et al., 2004). Based on these findings, Van Dun and Kumar (2022, under review) also found that a manager with a transformational leadership style (implying high EI and charisma) increases employees' acceptance of new technology adoption.

Finally, several organisational scholars identified that the use of an incentive system can mitigate resistance to change (Davis & Songer, 2002; Ferron, 2018; Venkatesh & Bala, 2008). When a change recipient will be rewarded for adopting new technology, the perceived usefulness of the innovation can increase and reduces resistance to change.

As can be seen, a large body of literature explored resistance to change and corresponding mitigating strategies. However, resistance can vary in different contexts; hence, practices need to be adapted accordingly. The aforementioned reasons for resistance and corresponding practices served as a basis for this study but needed to be expanded in the study-specific context of introducing BIM in the German AEC sector.

3. Methodology

3.1 Research Design

The objective of this research was to gain profound insights into the extensive experience of the BIM implementation process in the German AEC industry, observing the underlying reasons for employee resistance to technology adoption. Therefore, a qualitative study was deemed optimal to explore in-depth how people perceive change and what underlying motives lead to resisting change. Accordingly, this study aimed to identify new concepts that contribute to or complement current literature on management practices related to employee resistance to change in the specific context of introducing of a new and disruptive technology in the German AEC sector.

This research followed an abductive approach to investigate the phenomenon of resistance to change. The objective of abductive reasoning is to generate plausible and conjecturable explanations for the phenomenon of theoretical interest. Whereas a deductive approach aims to confirm prior knowledge, an inductive approach seeks to demonstrate the probable generalisability of a situational reality (Bamberger, 2018). In simpler terms, "deduction proves that something must be, induction shows that something is operative; abduction merely suggests that something may be" (Locke et al., 2008, p. 907). While deductive and inductive reasoning can be regarded as strong approaches, abductive reasoning is considered to be the weakest form of the three. Yet, many studies that aimed to extend previous theories were in fact frequently driven by abductive reasoning. In abductive reasoning, an a-priori theory – in this case, Kotter's (1996) and Stouten et al.'s (2018) CM models and resistance to change literature – serves only as a foundation for uncovering peculiarities that require more explanation and resolution. It facilitates the researcher to generate a new or alternative conceptual framework, which is based on just a plausible assumption and some insights into what this explicit assumption might mean for the new framework (Locke et al., 2008). A major advantage over the deductive approach is that abductive reasoning uses a specific context, employing "contrastive logic" as a means of extracting "meaning and insights from otherwise hidden patterns in the data" (Lipton, 2004 as cited in Bamberger, 2018, p. 7). One essential difference to inductive and deductive studies is the role of the framework. In studies based on abduction, "the original framework is successively modified, partly as a result of unanticipated empirical findings, but also of theoretical insights gained during the process (Dubois & Gadde, 2002, p. 559). In this sense, abductive reasoning can be considered a cross-fertilisation approach, meaning that new combinations are created by mixing established theoretical models and new concepts derived from confronting reality (Dubois & Gadde, 2002) to explain the phenomenon of theoretical interest; this will eventually contribute to scientific theories. Accordingly, this study aimed to test and expand prior knowledge about OCM in the specific context of introducing a new and disruptive technology in the German AEC industry; thus, an abductive approach was considered most appropriate.

3.2 Data Collection

In order to collect qualitative data, four comparative case studies were adopted and, given the limited time frame of this study, 18 interviews were conducted in total. The aim was to conduct interviews with change drivers (managers) as well as with change recipients (employees) in each company to explore the implementation process of BIM on the one hand and to identify underlying reasons for resistance and strategies to overcome employee resistance to technological change on the other hand.

A purposive sampling method was identified to be most appropriate for this study; it allowed the researchers to purposefully select the sample to obtain in-depth information needed to answer the research question (Saunders et al., 2009). To answer the research question, three suitable companies that already promoted BIM on their websites were identified via desk research and contacted via e-mail. Additionally, one company was selected through the personal network of one of the researchers. To receive a holistic picture of the implementation of a new technology the three different AEC branches, architecture, engineering, and construction as well as a general constructor were selected as comparative cases for this study. To explore the entire phenomenon of resistance to change, it was decided to choose companies at different stages of adoption; one of these four companies has not yet implemented BIM at all.

The following table (Table 2) summarises the companies' characteristics and provides information about the interviewed participants. All AEC companies were located in the northwest of Germany and ranged from small to large-sized companies with BIM experience between zero and seven years. The respondents were between 27 and 63 years old and had 1 to 34 years of experience in their respective position.

3.2.1 Interview Participants

No. of Interviewee	Designation of Interviewee	Gender (Male/Female)	Age	Years of Experience in that Position	Type of Design Firm	Size of Firm (by no. of employees)	Approximate years of BIM experience
Int. 1	CEO	M	63	7 years	Architecture	Large	7 years
Int. 2	BIM Coordinator	F	41	6 years	Architecture	Large	7 years
Int. 3	BIM Manager	M	47	6 years	Architecture	Large	7 years
Int. 4	BIM Coordinator	M	35	4 years	Architecture	Large	7 years
Int. 5	Leader of the BIM management department	M	30	2 years	Technical building services	Medium	3 years
Int. 6	CEO of structural and civil engineering office	M	54	22 years	Technical building services	Medium	3 years
Int. 7	Construction engineer	M	41	12 years	Engineering	Small	None
Int. 8	Technical draftsman	M	51	34 years	Engineering	Small	None
Int. 9	Structural draftswoman	F	27	6 years	Engineering	Small	None

Int. 10	Structural engineer	F	29	6 years	Engineering	Small	None
Int. 11	BIM Manager	M	48	7 years	General contractor	Large	7 years
Int. 12	Logistician	M	35	9 years	General contractor	Large	7 years
Int. 13	Master carpenter	M	31	15 years	General contractor	Large	7 years
Int. 14	BIM overall coordinator – before foreman on the construction site	M	32	1 year/11 years on the construction site	General contractor	Large	7 years
Int. 15	Architect	M	49	5 years	General contractor	Large	7 years
Int. 16	Specialist planner for building services	M	28	3 years	General contractor	Large	7 years
Int. 17	Production manager	M	37	14 years	General contractor	Large	7 years
Int. 18	Deputy production manager	M	43	1 year	General contractor	Large	7 years

Table 2: Interviewee profiles and company characteristics.

3.3 Research Instrument

For this thesis, semi-structured interviews were chosen as main research instrument. Semi-structured interviews are useful in qualitative research because they enable the researcher to get deep insights and to explore perceptions and opinions of respondents in terms of complex issues and phenomena (Saunders et al., 2007). Moreover, semi-structured interviews are flexible and allow probing questions to obtain more detailed information and elaboration of specific answers. By means of a certain structure, the researcher is further able to guide the interview in the desired direction. The special feature of semi-structured interviews is that, on the one hand, they allow the researcher to follow a pre-determined format that facilitates comparison between codes later in the analysis; on the other hand, the semi-structured format gives the freedom to adapt the interview according to the respondents' answers (Louise Barriball & While, 1994). Despite the benefits of semi-structured interviews, there are also some drawbacks that must be considered. Interviewers must be empathetic, and they must also have a thorough knowledge of all relevant content-related questions. The preparation and execution of interviews are time-consuming and labour-intensive and large amount of collected data sometimes must be logged and analysed over many hours. Moreover, semi-structured interviews are better suited for a small number of people that are going to take part in the research due to the amount of work and time required. Additionally, semi-structured interviews might be accompanied by some forms of bias as, for example, interviewer or response bias. Another limitation is that findings from qualitatively based interview studies do not enable generalisations about the whole population as it is often based on a small and unrepresentative number of cases. Yet, even if results cannot be generalised, they provide in-depth and detailed information.

The semi-structured interviews were conducted in German and afterwards translated into English by the researcher who is a German native speaker and fluent in English.

In total, 18 interviews were conducted eight of which can be considered change drivers (managers) and ten of which can be considered change recipients (employees). On average, each interview lasted 45 minutes, with the duration ranging from 30 to 60 minutes. The interviews were supposed to take place on-site, however, due to Covid-19 regulations, ten interviews took place in a virtual environment via a teams-meeting. Prior to the interviews, a small questionnaire was sent to all interviewees via email asking for the participants' demographics, such as position, age, department, gender, and years of experience in their current position; this allowed time saving during the actual interviews. A participant information sheet and a consent form, in which the interviewee agreed to the data collection method and participation in the study were sent to each participant in advance. Each interview was recorded with the interviewees' consent either via mobile phone or via the recording functions of the chosen communication platform, depending on whether the interview was conducted on-site or online. The interviews were transcribed verbatim, concealing any personal data.

3.3 Data Analysis

After all interviews were transcribed, a combination of two coding methods was chosen. One, known for its structure, is the Gioia et al. (2013) methodology, and the other one, renown in exploratory research, is the Thematic Analysis developed by Braun and Clarke (2006). While the former coding method of Gioia et al. (2013) can be considered a universal method for structuring qualitative data, a thematic analysis is more concerned with *how* qualitative data are actually coded, analysed, and interpreted. The two approaches are interlaced and are described in the following.

The central idea of Gioia et al. (2013) is to offer a qualitative method that facilitates the organisation of previously collected data and helps to assemble them into a more structured form while developing new concepts or grounded theories. The research method is based on three categories that build on each other. It starts with the creation of the 1st order concepts, which closely follow the respondents' answers and choice of words; here an immense number of categories can be expected. In the 2nd order analysis, the researcher starts looking for similarities and differences between the many categories in order to link them together and get a more manageable number, which should not exceed 25-30 categories. The remaining categories are then given a label, preferably containing the respondents' terms. Now the researcher begins to look for a deeper structure within the range of terms. At this stage of the analysis, the theoretical work begins with the investigation of whether themes can be derived from the emerged concepts that help to contribute to the explanation and description of the phenomenon under study. Once a so-called theoretical "saturation" and a manageable number of concepts and themes have been reached, an attempt is made to further refine the emerged 2nd-order themes into overarching overall

dimensions. Finally, the totality of 1st order concepts and 2nd order themes and the emerged aggregate dimensions (3rd order) form the basis for building a data structure. The Gioia method depicts a very rigorous process of structuring the data but does not explain exactly *how* data are analysed. Therefore, the work of Gioia et al. (2013) is used in combination with a thematic analysis that describes the process in more detail.

Braun and Clarke (2006) define thematic analysis as "a method of identifying, analyzing and presenting patterns (themes) in the data (...) often it goes beyond this and interprets different aspects of the research topic" (p. 79). The writing process can be considered an *integral* part of the analysis and is a *recursive* rather than a *linear* process, as the researcher keeps moving backwards and forwards through the stages to make gradual adjustments. A thematic analysis follows six general steps. In the first step, the researcher needs to transcribe the oral data into a written form, in which he/she can already become familiar with the data. After transcription, repeated reading is required to ensure that the data is actively absorbed while already looking for meanings and patterns. The second phase is about developing initial ideas, which relates to Gioia et al.'s (2013) 1st order concepts. When the researcher has become fully familiar with the data, he/she can start to create initial codes by identifying interesting features in a systematic style. In the third phase, the analyst can start searching for themes by compiling the codes into potential themes, which corresponds to the 2nd order themes of Gioia et al. (2013). Therefore, the researcher needs to change perspective by now focusing on the broader level of themes rather than codes. In this sense, the actual analysis begins, as the researcher must analyse the different codes by determining which codes can be combined into an overarching theme. The fourth phase involves reviewing and refining the eligible themes. It must be ensured that the data within each theme matches meaningfully, while there must be recognisable and clear distinctions between the different themes. In this phase, the researcher must begin to compare the emerged themes with existing literature to check if any precedents and/or new concepts can be found (Gioia et al., 2013). Once no substantial added value emerges, the researcher can stop refining the themes. In the fifth phase, the final themes are defined and named by specifying and refining each theme once again, which corresponds to Gioia's aggregate dimensions (3rd order). The main aim here is to identify the 'essence' of what each theme implies while determining which aspect of the data is covered by each theme. Now a detailed analysis of each theme needs to be written and carried out. The researcher must start to interpret by recognising the 'story' of each theme, including how it belongs to the broader overall story that one is trying to tell with the data. Each topic must have a name that is concise, meaningful, and immediately gives an idea of what the theme entails. The last phase involves the final analysis and the creation of the report, which requires a set of fully specified themes. The analysis (written elaboration incorporating data extracts) needs to include a concise, logical, coherent, and interesting explanation of the story provided by the data within and between the themes.

Given the abductive approach of this study, emerging concepts were compared to Kotter's (1996) and Stouten et al.'s (2018) CM models and resistance to change literature to see if the conceptual models could be confirmed by collected data or whether they needed to be adapted in the context of implementing new technology in the German AEC industry.

4. Findings

This research aimed to explore how German construction leaders implement technological innovation and manage potential employee resistance to technological change. To address this research question, the results are structured by firstly addressing how technological innovation is best introduced in the AEC industry and, secondly, after examining the reasons for resistance to the introduction of new technology, methods for managing and overcoming potential resistance to technological change are identified. To further illustrate the results, Figure 1, Figure 2, and Figure 3 have been elaborated and depict the three different data structures as recommended by Gioia et al. (2013).

4.1 Implementation of a new Technological Innovation

Before embarking on organisational change, a company must **recognise and communicate the urgency of the technological change** (see Figure 1). Throughout the interviews, many respondents indicated that the first step is to *identify current problems and to recognise the multiple opportunities* offered by BIM since the technology could present a solution to many problems. Several respondents pointed out that 1 – 2 years of *exploratory talks* are needed, in which the world of BIM as well as its advantages and disadvantages are carefully discussed and evaluated. When interviewing participants from the four companies, both leaders and employees, all emphasised that BIM might represent a fundamental change for the entire industry. Nevertheless, the managers pushed the introduction of BIM and constantly communicated the urgency of the change to motivate action. One BIM manager, for example, stated that the introduction of a software like BIM is long overdue compared to the development in Scandinavian countries; however, “the move from 2D construction drawings to a 3D digital model represents a paradigm shift for the entire AEC industry that needs to be carefully considered”.

Once the decision to adopt BIM has finally been made, the next step is to **build a leading BIM coalition possessing high emotional intelligence (EI)** that is responsible for steering the entire organisational change process. Many of the respondents stated that the steering committee needs to *designate a BIM agent* (or “BIM champion”) *with various soft skills* who is expected to become an expert in the field by exploring the diverse BIM variants and corresponding software providers. The BIM agent needs to possess a set of specific personalities and qualities, such as empathy as well as communication and problem-solving skills. The change agent is responsible to drive the change process forward while implementing BIM as smoothly and accurately as possible. One of the respondents, for example, pointed out that “there is always a BIM champion who holds the different working groups together and drives the whole process forward”. Depending on the size, a company may even consider setting up a BIM department to ensure a successful transformation. Due to missing know-how, the majority of respondents stated that they decided to *seek renowned external expertise* by hiring a consultancy firm or an external BIM manager to ensure that BIM will be implemented properly. During the interviews, almost all respondents stressed that the

choice of the right BIM consultant is key to a successful implementation. Beyond hard skills (technical knowledge), the external consultant must possess various soft skills, i.e., much emphasis should be placed on communication and involving employees rather than focusing on technical features. Several interviewees reported that they had to realise that the change will fail if the wrong consultancy is chosen. One of the respondents, for example, stated that the first attempt to change failed because of an external consultant who told staff who had always done a good job, “what you have done so far is not good and I can do it better”; the interviewee continued by saying that "it was ultimately not the case, and when a consultant acts like this, you cannot count on the support of the workforce”. Conversely, another respondent stated that they were satisfied with the work of the external BIM consultant as “he focused a lot on communication and not on the functionality of BIM; and he always got all stakeholders involved, which is very important in such a planning consortium as everyone has different concerns”.

Together with a suitable consulting firm, the guiding coalition must **develop and communicate the new BIM vision and objectives** it wants to achieve with BIM. First, some *fundamental questions* need to be clarified. Several respondents underlined that there are various options and BIM variants with respective advantages and disadvantages, which must be carefully examined and evaluated. In accordance with the vision and the set goals, it needs to be decided which BIM variant and which software provider is best suited for the respective circumstances. Depending on the size and structure of the company, a suitable implementation approach needs to be chosen. Together, a *roadmap needs to be defined*, which serves as a general guideline for a time-based implementation. One of the managers pointed out that it is important to “prioritise the various goals in a roadmap to set various milestones during the implementation process”. The next step is to *spread the new BIM vision* and ensure transparent communication during the entire process to build confidence and trust. Many respondents underlined that the vision must be disseminated in multiple information events and intranet reports that need to be continuously updated. One of the managers said the goals need to be communicated again and again so that even the last one understands where the company wants to go. Another respondent stated, “the *why* is more important than the *what* and the *how*”, i.e., special focus needs to be set on *why* the company wants to implement BIM and achieve specific goals rather than focusing on what BIM entails.

After creating a good basis, it is important that managers actively **motivate and inspire employees for the change** by offering, for instance, a *well-designed BIM training*. At the beginning of the training, several respondents advised conducting a small employee survey in which employees are asked to assess their willingness to learn something new. One of the managers pointed out that this first step is important because “it's true that 99 per cent of the people tend to be on the upper right, which means that they are highly interested in their way of working, which is perhaps also the reason why people show more curiosity and don't react so negatively afterwards”, meaning the first barrier has already been overcome. Then the basic training begins in which everyone is welcome to participate. In the interviews, most respondents indicated that the basic training lasts 3 – 5 days. Furthermore, they stated that the newly acquired knowledge must be internalised for several days. After a few days’ break,

a 2-day detailed training for specialist workers will be offered to acquire subject-specific knowledge. In the interviews, many respondents made clear that it is crucial to actively involve the participants by offering an interactive learning programme, i.e., the focus should be placed on the practical learning of the programme and less on theory. Accordingly, one manager stated that he is “firmly convinced that the most important thing is to work on the model right from the start, not to dive into theory or processes or goals for a long time, but to do it quickly”. To consolidate what has been learned and to actively put the training into practice, pilot projects are carried out for this purpose in which the employees are supposed to gain more confidence using the programme in their daily work. Moreover, it is important to *create a learning environment* to ensure a pleasant learning atmosphere. Many respondents indicated that a dedicated training room needs to be offered. Moreover, an enthusiastic BIM trainer who inspires willingness and curiosity needs to be engaged.

Lastly, to not fall back into old working routines, it is important to **consolidate the change and cultivate the new way of working.** A common statement of the interviewees was that it is essential to pay equal attention to all phases of the process by continuously *monitoring and supporting the change* process through, for example, “development boards” that review the set goals step by step. One BIM manager indicated that it is a common problem that optimisation or change processes often lead nowhere as there are no control bodies that check whether ideas are implemented and goals are achieved. He mentioned that it is important to pick up and track all issues. By means of development boards, the path of ideas is continuously monitored and recorded by moving ideas from “in process” to “completed”. He went on to state that many processes fail because “it is often like a complaint box”, i.e., complaints go in there, but they are neither tracked nor does anyone feel responsible for dealing with them. Thus, a person needs to control the development board to guarantee that the process is continuously driven forward. After most processes have been adapted, many respondents underlined that it is crucial to take a *fundamental decision* to ensure that 2D programmes and 3D software do not run in parallel. If employees still can work with 2D programmes, there is a great tendency to fall back into old ways of working. According to one employee, after the pilot project, a fundamental decision needs to be taken on whether it should be switched to 3D completely. Managers should not weigh up per project but make a clear decision by communicating that "from now on, only Revit (3D software programme) will be used for new projects". To cultivate the fundamental decision, the vision, including new norms and values, must be lived by everyone. If one department (manager) lacks passion, a smooth working process between the different departments will be impaired, which can lead to a relapse into old routines. One of the interviewees pointed out that “it’s either everyone or no one”, meaning all involved departments must be equally passionate about it and live the vision, otherwise “the whole BIM-thing will fall asleep again”. The majority of respondents further stressed that especially the upper layers, i.e., the top and middle managers, must spread passion and consistency to make the change authentic.

Based on the interviews, the following section discusses the management of resistance to change, one of the main barriers in the implementation process.

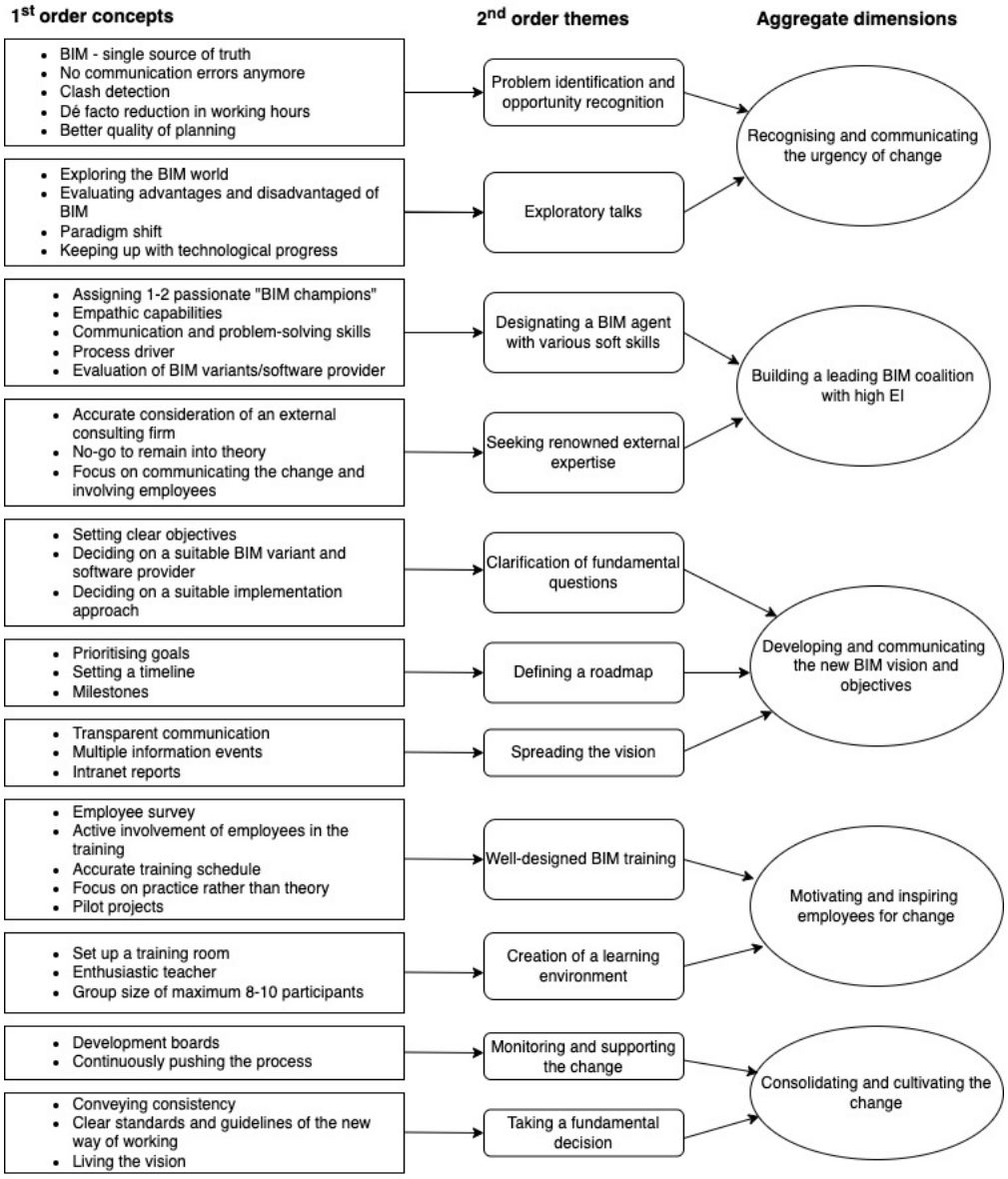

Figure 1: Data structure for the implementation of a new technology.

4.2 Management of Resistance to Change

As mentioned in the introductory paragraph of this section, German construction leaders need to manage and overcome certain barriers that arise during the BIM implementation process; particular attention needs to be paid to employee resistance. The second part of the research question of this thesis aims at understanding how German construction leaders can manage and overcome potential employee resistance to change. However, to counter this barrier, it is crucial to first identify the sources of their resistance to address them most effectively (see Figure 2).

4.2.1 Sources of Employee Resistance

From the interviews, two sources of resistance could be identified, namely internal resistance and external resistance. German construction managers need to deal with internal resistance from their employees and external resistance from the company's business partners. Due to the reason that multiple disciplines are involved in a construction project, each discipline needs to work with BIM so that all information can be combined into one 3D model. As currently only larger firms have already implemented BIM, managers also must convince their business partners to also use BIM in a joint project. Since the focus of this work is on internal resistance of employees, external resistance of business partners is only touched upon.

From the interviews, particular reasons for **internal resistance of employees** could be identified. One of the most reported issues by the respondents was the *generational barrier*. While the younger respondents were quite open to the introduction of BIM, the older interviewees showed much more resistance. A striking phrase from a construction worker was, "we've always done it this way and it worked well, why should we change it?", which indicated that they want to keep the tried and tested software. Two others stated that they don't want to make effort to learn anything new, citing that they are close to retirement. Similarly, another employee said that he is willing to learn something new that is useful for his personal life, i.e., his personal development, but he does not see the urge to learn something new in his working life because he cannot use it after retirement and besides "it will take years anyway till the construction industry is ready to switch to BIM anyway". Others in turn said that BIM is only a "flash in the pan", meaning they do not believe that the technology will prove itself. On closer examination, it became clear that older employees particularly are afraid of being left behind by other colleagues because they can no longer keep up with the rapid technological progress. Many younger interviewees noticed that this leads to certain inertia which is reflected in their behaviour. Often, older employees do not even bother to familiarise themselves with the programme, but instead, pass on certain work (which they can no longer do themselves) to younger employees. A manager explained the difference in the attitude between older and younger employees by saying that younger ones are more IT-affine because they grew up in a digitalised world and already had experiences with 3D modelling during their studies, however, older employees sometimes have no computer know-how at all. He further highlighted that older people find it harder to learn something new, especially concerning new technologies as " general curiosity is just missing, and they feel that they lack the basic skills to understand how to use a new technology (BIM)".

The interviews also revealed a general resistance to the *functionality of BIM* per se. Many respondents made clear that the perceived usefulness of the software is rather low. One manager pointed out that many employees complain about technic-specific aspects that interfere with their daily work. Similarly, many respondents stressed that the software is not yet mature and containing too many sources of error. In addition, respondents who are working in the offices mentioned that you need to have a "Ferrari as a computer that is able to process tons of data without crashing". Several respondents also criticised that it is not

useful to use a laptop on the construction site because of bad weather conditions, for example. Numerous employees do not believe in the actual usefulness of the software and claimed that programme manufacturers just make empty promises to have sales arguments; according to one interviewee “everything seems to be perfect but in reality, there are many failures, and the manufacturers have no idea of the daily work of an architect, constructor, or engineer”. Another frequently reported concern was the lack of interoperability, i.e., BIM can only function smoothly if all departments have the same standards and if the various 3D software programmes are compatible. One employee of the general construction company, for instance, complained that the different software programmes were not compatible so there was no smooth working process and flow of information, which led to repeated errors. Consequently, many interviewees pointed out that functional barriers can lead to a lot of frustration and a lack of trust in the software, resulting in a reversion to “AutoCut”, the tried and tested 2D software programme.

Throughout the interviews, many respondents further criticised the *insufficient support of the management*. Several employees, for example, complained about a suboptimal process integration, which hindered a smooth working process. According to a production manager, some departments were much further along in the implementation process and were more passionate than others so there was no optimal flow of information. Due to the poor information flow and unbalanced process integration in the different departments, he added that they “got chaos in production, which led (them) to switch back to the old and proven software”. Many interviewees pointed out that they were initially concerned that there were not enough people with relevant experience, which eventually leads to being on your own and being a "lone wolf". One employee, for example, said that a workshop usually only shows the "standard functions", which means that you eventually must work out the special functions, needed for daily work, on your own; besides the normal work, this requires a lot of energy and self-effort. Similarly, another employee complained that “when you call the software provider for support, they often just look in the manual themselves and end up not offering a solution to the problem - you are just left with the problem and have to live with it”. Many respondents also highlighted that they were afraid of not being rewarded for the extra work. A respondent of the company that has not yet introduced BIM even fears that "the company might spend too much money on implementation, which means he might suffer financially because he does not get his Christmas bonus anymore. He assumes that "if the company makes a profit, I will also benefit, but if the company cannot afford anything, neither can I". Throughout the interviews, several respondents said that resistant behaviour is shown because the management lacks the assertiveness and passion that is required to successfully implement new technology. One respondent reported that the first BIM implementation attempt failed because the management did not exert any pressure by taking out the cudgel and saying: “we have to do this *now*”. If management does not lead by example, show passion for the new vision, and demonstrate consistency, staff cannot be expected to be motivated and behave in a way that supports the change process.

As previously mentioned, managers did not only have to deal with internal resistance but also with reasons for **external resistance of their business partners**. Throughout the

interviews, it became clear that especially smaller companies show resistance toward the adoption of BIM as they fear a *loss of efficiency*. Almost all respondents of the engineering company, that has not yet introduced BIM, complained that costs are too high and too much time is spent on implementing a new software programme. In particular, the engineering firm's executives pointed out that they can no longer complete their projects on time, meaning they not only have to spend money on the introduction but will additionally lose money. A common phrase used by several respondents was "never change a running system", meaning they did not want to see the urgency of implementing a new system as the established system had proven itself. Another complaint by many respondents was that there are still *no clear standards and guidelines from the chamber of architects*. Several interviewees emphasised, for example, that the "Leistungsphasen" (work stages), which were previously precisely defined according to HOAI standards, are getting mixed up and the new fee distributions are not yet sufficiently regulated in some cases. In addition, many respondents underlined that the BIM field is simply too new so it is challenging to find new people with expertise in this new technological area. On closer inspection, several respondents revealed that they are generally *afraid of technological advancements* as one technological solution might replace their jobs one day or lead to a successive loss of business partners. One architect, for instance, stated that he does not want "the software to steal (his) model".

The above-mentioned reasons can cause resistant behaviour, meaning people do not show change-promoting, but rather resistant behaviour, which can ultimately lead to a failure of the change process. To successfully manage the change process, leaders need to adopt certain strategies to counteract and overcome resistance, which are discussed in the next section.

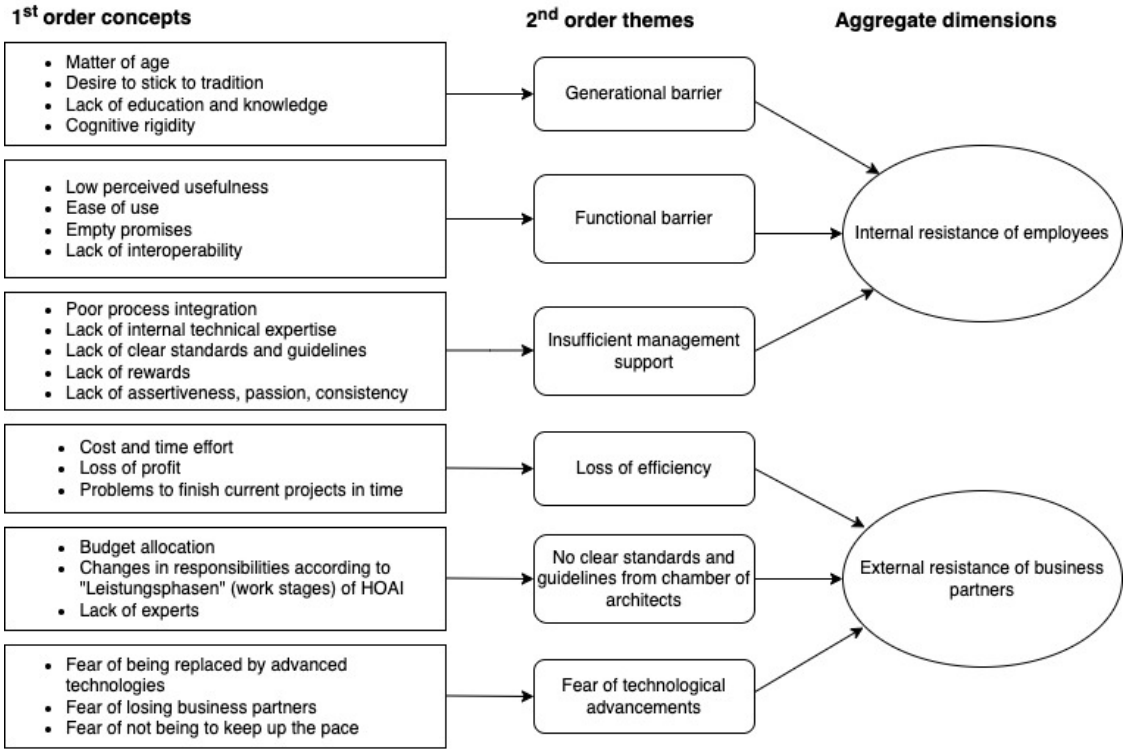

Figure 2: Data structure for sources of resistance.

4.2.2 Management of Resistance to Technological Change

In the interviews with both managers and staff, it emerged **that empowering and involving employees** in the entire change process is a key strategy to overcome resistance. The majority of respondents underlined that it is crucial to *co-opt* employees and involve them in the decision-making process right from the beginning. One of the respondents, for example, stated that "you have to turn those affected into participants; you have to take the people along with you". Similarly, another manager pointed out that "it is essential to interview people right from the start, asking them what is particularly important to them, allowing them to develop optimisation potential themselves […]. He further said that "people need to get the chance to say what sucks for one hour every month. In this monthly working group, they can bring it up; together it will then be looked for an overarching solution that fits into the overall concept". Giving employees the opportunity to contribute their own ideas fosters a sense of being part of the whole process and shows that their opinion is valued by the upper layers. In addition, the "idea-givers" want their ideas to eventually be put into practice. This leads them to actively drive the process because, as one respondent stated, "you suggested the idea yourself, so, to some extent, you are responsible for making your idea to a success." Throughout the implementation process, it is then essential to apply a pull strategy by continuously *encouraging employees to raise their voices.* Managers need to animate staff to contribute both ideas and criticism so that optimisation potentials or underlying concerns do not remain hidden. Furthermore, numerous respondents emphasised that the *competencies of older employees need to be particularly valued.* One manager, for example, reported that they tested a BIM tool, especially with older employees and specifically asked them for advice and feedback, which turned out to be a win-win situation. On the one hand, the managers could benefit from the know-how of the experienced employees by receiving constructive criticism; on the other hand, the (older) employees felt valued as their knowledge was demanded and they could actively participate in the process.

Another important aspect to guarantee a successful transformation process is the selection of a **BIM agent possessing transformational leadership characteristics**. Throughout the interviews, all BIM managers showed *empathic capabilities*, which was shown in their compassionate and reflective behaviour. All of them seemed to be trustful and sensitive to dissatisfactions while knowing how to approach respective situations. Several respondents pointed out that a BIM agent needs to be able to listen to and solve problems while also understanding that the change from the construction drawing to a digitised 3D model entails a paradigm shift that triggers specific anxieties. These anxieties often require individual treatment; one of the interviewed managers stated that "if you are unable to address an employee's fears and concerns, an alternative solution should be considered for this employee to provide confidence". Many respondents stressed that a BIM agent must be *able to recognise and seize an opportunity to promote BIM benefits*. If a manager can sense the right moments, he or she can promote BIM, for example, by providing hard facts, such as no negative returns anymore. Moreover, employees should recognise the benefit of receiving more autonomy as they can obtain the necessary information themselves without having to

call someone who may not be available at the given moment. Many respondents admitted that this not only saves a lot of waiting time but particularly many moments of frustration. In addition, BIM agents need to recognise the best moments to stimulate employees' imagination through spatial vision. Besides sensing and seizing the right moments to promote the advantages of BIM, several interviewees pointed out that a good BIM agent needs to *encourage social adjustment and personal experiences*, for example, by being sensitive to possible followers who are willing to support BIM in respective projects. One respondent recommended looking for older supporters that are willing to promote BIM and its associated benefits; people are rather receptive to new ideas coming from people in their peer group because they feel a greater connection to people that do the same job. If a trusted person promotes a technological solution, there is a higher tendency that more and more people start adopting the new way of working. More specifically, the bandwagon effect will lead to social adaptation, i.e., if most people start using the new technology, even the last resisters will surrender the social pressure. Almost all respondents highlighted that it is important to encourage positive experiences made with BIM by, among others, telling the success stories of other employees.

Although it seems to be obvious, almost all respondents stressed the importance of **intensive and constant management support**. Here, they stated, that it is crucial to *set clear standards and guidelines* to clarify new conditions and create a safe framework. One of the BIM managers explained that employees were afraid that current responsibilities according to HOAI standards will change because of BIM and that they might be accused of faults occurring during a construction project. To deal with these insecurities, it is important to establish intermediate control bodies and concrete one-pagers to ensure that responsibilities remain and to guarantee that the various work steps are continuously reviewed and approved by various control units. The management must further ensure *transparent communication and adequate education*. To deal with concerned employees it is significant to conduct 1-1 conversations, for example, and provide multiple information events and post intranet reports in which the benefits of BIM as well as the interrelations are explained again and again. Several respondents underlined that it is more important to communicate the "why" rather than the "what", for example, by making clear *why* the introduction of BIM is also beneficial for the employees (and not only for the company) and *why* they set and prioritised specific goals. To create assistance it is vital to provide constant accessibility and active support throughout the entire implementation process. Several staff members said that they want to call and get immediate help from specialists whenever they experience a problem. One of these staff members clearly said that he does not "want to be left on (his) own or live with a specific problem". Moreover, the upper management must ensure *relief and reward*. People need to be compensated for good work and their extra effort, not only by intrinsic but also by extrinsic incentives, meaning the extra work must pay off either financially or by providing better work equipment such as a better computer, for example. A commonly reported concern of the respondents was that they do not have the time capacity to learn something new as they already have a lot of time pressure in their job. To relieve employees, they must be pulled out of ongoing projects so that overtime and time pressure are avoided.

Besides the intensive and constant management support, almost all respondents made clear that the design and the execution of an **interactive training approach** that focuses on practice rather than theory is of vital importance. First of all, it is essential to create a *learning environment.* Many respondents indicated that a special training room needs to be set up to ensure a pleasant learning atmosphere for the participants. In addition, the training must be conducted by an enthusiastic workshop trainer who is competent and spreads passion that motivates the audience. The majority of interviewees emphasised that only a *practical training approach* will lead to success, i.e., less focus should be paid to theory and more to practice. One manager claimed that it is a "no-go to remain into theory". Similarly, another respondent said that the key is to start working *with* and *in* the model right from the start than to explain the functionalities. Therefore, an interactive BIM training needs to be offered in which employees could test the software and its tools in small groups or on their own. One respondent noted that workshop groups should not be larger than ten people, as individual help becomes more difficult when the number of participants increases. An interactive training approach also includes discussion, meaning there must be a lively exchange between the participants and the trainer. According to most respondents, a dynamic exchange during the training leads to initiative and productivity and prevents concentration and interest from waning. Employees who do not voluntarily register for BIM training should be actively put on the list to entice them and have the chance to convince them of BIM in the training. In addition, many interview respondents stated that application scenarios and pilot projects need to be offered to convince employees of the benefits and to make them confident in using the new software; one respondent also stated that "the benefits of BIM should not be explained to the workers, but they have to *experience* the benefits themselves."

Throughout the interviews, it became clear that individual reasons for resistance need individual treatment. If the reasons for employee resistance to technological change will not be managed properly, the transformation process might ultimately fail. In the next section, the main results will be summarised and discussed.

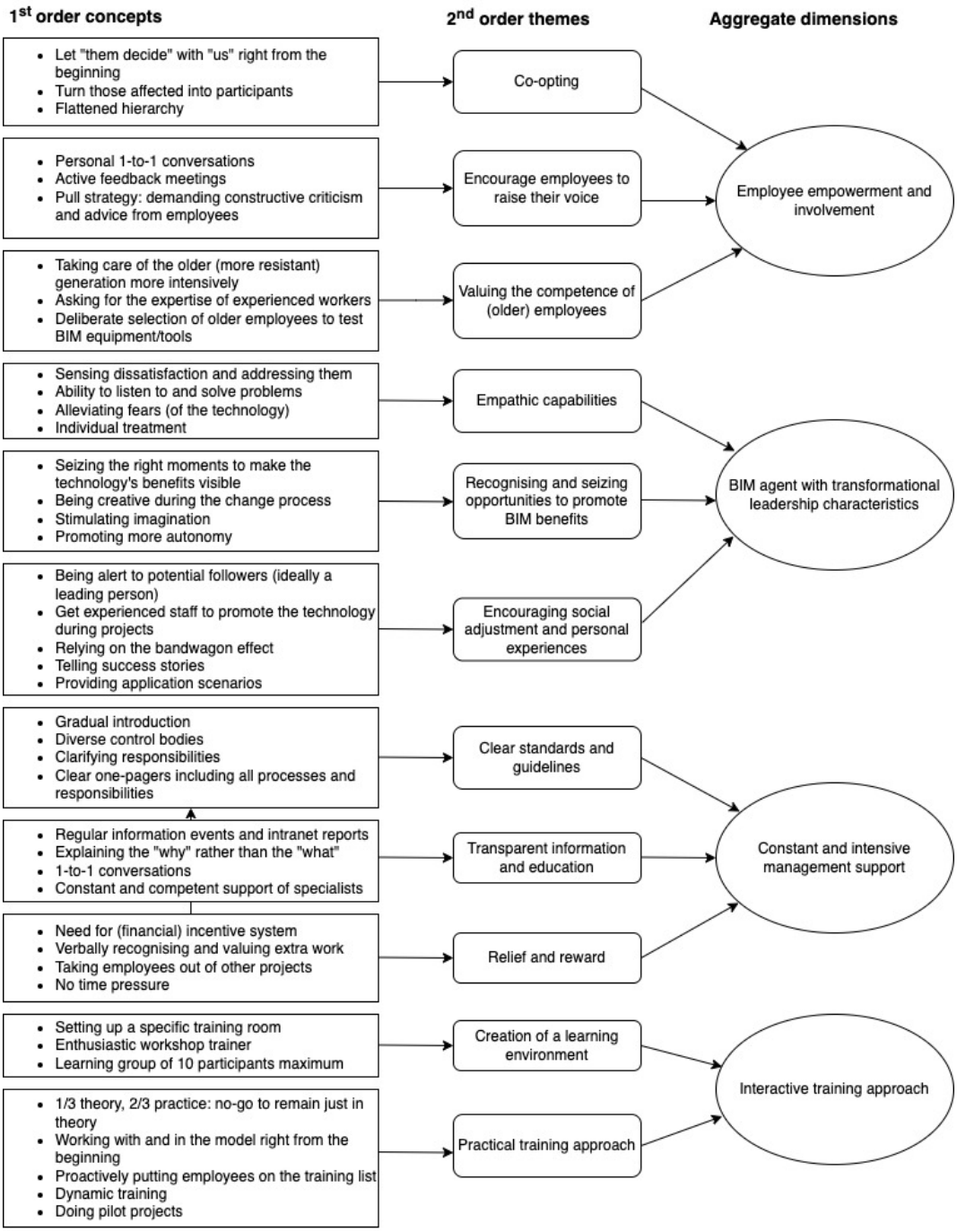

Figure 3: Data structure for the management of resistance to technological change.

5. Discussion

The next section discusses the results by comparing them with existing literature attempting to find corroborations and contradictions as well as new avenues of research. First, the theoretical contributions and the practical contributions will be addressed. Thereafter, the limitations of this study and suggestions for future research will be outlined.

5.1 Theoretical Contribution

In the following, the first part of the research question, i.e., how new technology is implemented, is discussed. Thereafter, the second part of the research will be addressed, which deals with sources and management of resistance to technological change.

5.1.1 Implementation of a new Technological Innovation

This study contributes to current OCM literature by refining CM models (Kotter, 1996; Stouten et al., 2018) with nuances pertinent to the specific application of these models in the context of high-tech innovations within the AEC industry (see Figure 4).

More specifically, the findings of this study highlight that a guiding coalition, consisting of a change agent and an external consultancy firm, with high EI will increase successful technology implementation in the AEC sector. Recent studies on organisational change have already identified that effective change agents are one of the key elements for successful change implementation (Lee & Yu, 2016; Maali et al., 2020; Wolpert, 2010). In contrast to well-known OCM models (Kotter, 1996; Stouten et al., 2018) that tend to emphasise the supporting role of a change agent, the findings point to the leading qualities and non-technical skills of a change agent. It was found that an effective change agent must possess a high level of EI to successfully manage the change process and overcome change-related barriers, where EI is the ability to recognise and control one's own and others' negative emotions (Wong & Law, 2002; Zeidner et al., 2004). This is in line with several studies that identified that a manager's EI will positively influence employees' attitudes toward adopting new technology (Schroeder et al., 2005; Zeidner et al., 2004). The results suggest, for example, that soft skills, such as empathy as well as communication and problem-solving skills, are more important than the technical competencies of the change agent, which is in line with Radzi et al. (2019) who found that a company must focus on soft skills and needs to select a change agent with a "good" personality when introducing new technology. In addition to selecting an empathic change agent, the findings propose seeking external expertise by hiring a consultancy firm when introducing technological change in an AEC company, which is assumed to lack expertise in this new area. Yet, it was found to be crucial to choose an external consultancy that has not just technical expertise but also social competencies and CM skills; i.e., the external consultant should involve employees in the change process and communicate the change intensively rather than emphasising functional aspects of to technology. This also relates to previous

literature (Maali et al. 2020; Pant & Baroudi, 2008; Radzi et al., 2019), in which the authors identified that organisations tend to spend too much attention to technological aspects while neglecting non-technical aspects when introducing new technologies in an organisation. Van Dun and Kumar (2022, under review) also recently noted the need to consider socio-emotional and change competencies when hiring new staff; the findings of this study indicate that these characteristics can also be applied when selecting a change agent and hiring an external consultant. Consequently, the following proposition can be suggested:

Proposition 1: *A guiding coalition, consisting of a change agent and an external consultancy, with high EI will increase the successful introduction of new technology in the German AEC industry.*

Second, the findings of this study stress the importance of motivating and inspiring employees through the provision of sufficient training resources during a technological change process, a process step that receives rather less attention in Kotter's (1996) model. In contrast to previous scholars on OCM practices that found a moderate correlation between training resources and change adoption (Lines & Reddy Vardireddy, 2017; Maali et al., 2020), the findings of this study, albeit qualitative, highlight the strategic importance of the right training conditions to motivate and inspire employees for change. This slight discrepancy might be explained by the disruptive nature of the technology (BIM) forcing many process adjustments and changes (Khosrowshahi & Arayici, 2012; Lines & Vardireddy, 2017) that need to be well-prepared for. Similarly, Young and Bernstein (2008) identified that higher levels of expertise were associated with more positive experiences with BIM. Based on the results, it can therefore be suggested that the more complex or high-tech technology is, the more training is required, which provides a fertile ground for future research. The findings propose to offer a well-designed training schedule prioritising practice rather than theory. Further evidence was found that the creation of a learning environment and an interactive training approach that focuses on a dynamic exchange between the participants and the workshop trainer, will engage participants and raise motivation. This is in line with current research, which consistently shows that interactive methods are associated with positive student outcomes, such as increased attention, interest in learning and satisfaction (Blingh, 1998; Burrowes, 2003; Freeman et al., 2014; Sivan et al., 2000). In addition, Bartlett (2001) also found that access to training, perceived social support for training from upper management, personal motivation to learn, and perceived benefits of the training are positively related to organisational commitment. Therefore, the following proposition can be suggested:

Proposition 2: *An interactive training approach, focusing on practice rather than on theory, and a pleasant learning environment will increase employees' readiness to use new sophisticated innovations, eventually leading to new technology adoption.*

Third, traditional CM models (Hamel, 2000; Jick & Kanter, 2003; Kotter, 1996) tend to peak early as they rather focus on encouraging the change and reducing resistance to change

(Westover, 2010). Yet, the findings underline that it is of vital importance to devote the same amount of energy to all phases equally and to not flatten towards the end of the implementation (Cameron & Green, 2020) . In earlier years, Lewin (1947) had already found that a group performance tends to revert to the original level after a period of quick change and advises stabilisation measures as part of the change process. The findings confirm that there is a high tendency of workers to slip back to the old way of working with 2D when the opportunity arises. The high tendency to fall back on document-based working methods might be explained by the nature of the industry (Bernstein & Pittman, 2005; Gilligan & Kunz, 2007; Volk et al., 2014) that tends to stick to traditional practices, such as established business models, processes, as well as legal and compensation schemes; eventually, this impedes the implementation process (Davis & Songer, 2005; Khosrowshahi & Arayici, 2012). With respect to the nature of the industry, an additional nuanced contribution to current literature can be made. The findings indicate that the AEC industry does not seem to be influenced by the culture of the country, but has its very own culture that is tradition-based and rather slow in adopting new technologies. This is in line with previous studies, underlying that stakeholders are only likely to embrace changes if the industry itself relinquishes its resistance to change (Ezcan et al., 2020; Henderson & Ruikar, 2010). Therefore, the findings suggest making a fundamental decision for or against the future use of the new technology to convey consistency and avoid parallel processes. This can be related to the initial assumption that BIM can be considered a transitional change process (see Theoretical Framework) that has an old and a new state (Jick & Peiperl, 2007); the fundamental decision introduces a new era and rounds off the active change process. Yet, to institutionalise the change and provide consistency, the new norms and values have to continue to be lived. Hence, the subsequent propositions can be made:

Proposition 3*: All phases of the technology implementation process need to receive the same amount of energy to consolidate the change. Moreover, the AEC industry has its own specific culture and is hardly influenced by the culture of the respective country*.

Lastly, regarding the remaining steps found in Kotter's (1996) and Stouten et al.'s (2018) change models, this study further substantiates previous theoretical findings. The first step of recognising and communicating the urgency of technological change is consistent with what has already been found in theory (Jick & Kanter, 1992; Judson, 1991; Kotter, 1996; Luecke, 2003; Stouten et al. 2018). In addition, further evidence could be found for the development and communication of a new vision and corresponding goals (Hamel 2000; Jick & Kanter, 1992; Judson, 1991; Kotter, 1996; Luecke 2003; Stouten et al., 2018). The findings of this study further underline current theoretical approaches (Hamel 2000; Jick & Kanter, 1992; Judson, 1991; Kotter, 1996; Luecke 2003; Stouten et al., 2018) by emphasising the need to consolidate and cultivate change by, among others, setting clear standards and guidelines to ensure consistency and rewarding employees for extra efforts. In addition, the study supports existing OCM models (Hamel 2000; Jick & Kanter, 1992; Judson, 1991; Kotter, 1996; Luecke 2003; Stouten et al., 2018) by indicating that the new vision, including the norms and

values of the new organisational culture, needs to be lived and disseminated primarily by the top and middle management. Ultimately, this will change the mindset of staff, away from the traditional document-based way of working with 2D to a new digitalised way of working with 3D. Hence, the following proposition can be made:

Proposition 4: *Further steps of Kotter's (1996) and Stouten et al.'s (2018) models can be confirmed; a) recognising and communicating the urgency of (technological) change, b) developing and communicating the new vision, and c) consolidating and cultivating the (technological) change will positively influence employees' intention to use advanced technologies, ultimately leading to successful technology adoption.*

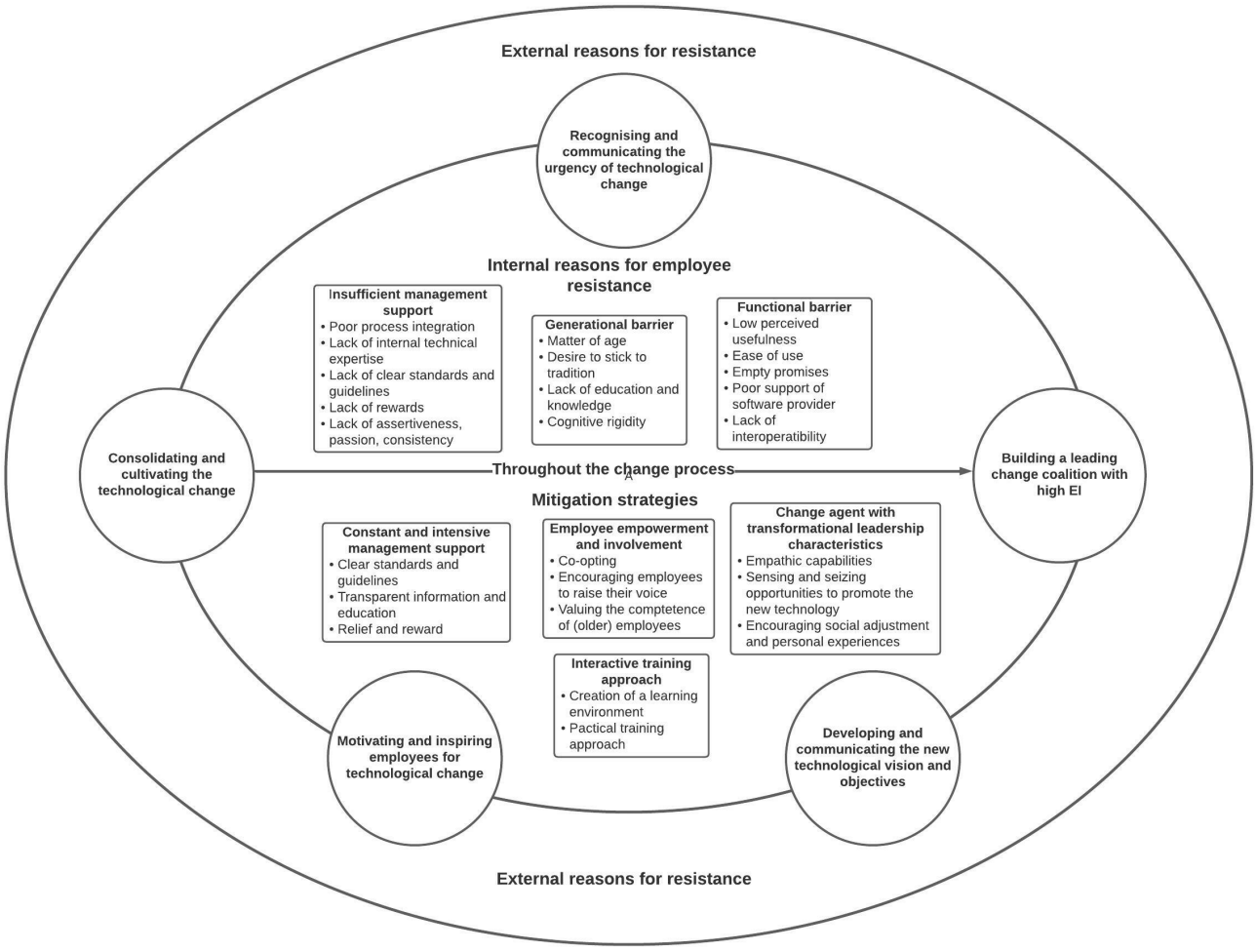

Figure 4: Cycle of technological change management.

5.1.2 Management of Resistance to Technological Change

This section addresses the second part of the research question of how to manage resistance to change. The findings of this study aim to add to the current body of knowledge by exploring sources of employee resistance and identifying appropriate strategies to mitigate resistance to technology adoption in the AEC industry. First, the identified sources of resistance are discussed, then the corresponding mitigating strategies will be outlined.

Sources of Employee Resistance

In contrast to previous literature that mainly categorised resistance as active and passive behaviour (Bovey & Hede, 2001; Hultman, 2006), positive versus negative and strong versus weak resistance (Lines, 2005), the findings of this study suggest to make a distinction between internal resistance of employees and external resistance of business partners, while the latter can be explained by the multidisciplinary nature of the sector (Erdogan, 2008). Due to the reason that this study concentrated on employee resistance, external resistance is not considered here, as it goes beyond the scope of this research. With respect to internal resistance, the findings highlight three barriers (generational barriers, functional barriers, and insufficient management support) that partly open new avenues of research.

First, in contribution to current resistance to change literature (Davis & Songer, 2002; Erdogan et al. 2008; Henderson & Ruikar, 2010; Schneider & Sting, 2020; Oreg at al. 2003, 2008, 2018, 2019; Venkatesh et al., 2008) the generational barrier has been found to be a major reason for resistance to technological change. The results show that younger people are generally less resistant to new technologies than older people. This is consistent with Davis and Songer (2009) who found that younger people use many technologies in their daily lives and therefore adapt to new technologies more easily than older people. The different attitudes toward technology adoption might also be explained by a study by Schneider and Sting (2020), in which the authors identified five distinct frames (utilitarian, functional, anthropocentric, traditional and playful). While the traditional frame affects a rather negative attitude to technology adoption, the playful frame affects a more positive attitude towards the introduction of new technologies (the other three frames are related to a neutral attitude). The findings of this study suggest that older employees rather fit the traditional frame, which is characterised by pragmatism and the fear of losing human labour status. In contrast, younger employees would rather fit the playful frame as the results indicate that they are more curious and open to new technologies. The generational-based resistance might further be explained by a lack of education and experiences with technological advancements in general, which leads to cognitive dissonance as older people might lack basic knowledge and skills to learn a new software programme. This is in line with Parsons et al. (1991) who identified that younger people have less difficulty learning new computer software than older people. In relation to this, older people argued that they are close to retirement, which shows general inertia that presumably relates to cognitive rigidity to embrace technological change. Oreg et al., (2008) define cognitive rigidity as “a form of stubbornness and an unwillingness to consider alternative ideas and perspectives” (p.936), which can cause change resistance.

Another explanation for the generational resistance might be the traditional nature of the construction sector (Khosrowshahi & Arayici, 2012), where 2D drawing is of highest value. The change from the traditional document-based working method to a digitised working method with a 3D model represents a paradigm shift for an industry that is known for having an older, presumably rather conservative, workforce (Choi, 2015; Schwatka et al., 2012). Consequently, the following proposition can be made:

Proposition 5: *Generational barriers (i.e., urge to stick to tradition, lack of knowledge and education, cognitive rigidity) can have a negative impact on employees' intention to use new and disruptive technologies and consequently hinder successful technology implementation.*

The other two identified sources of resistance (functional barriers, insufficient management support) are in line with current scholars on resistance to technology adoption. Similar to prior research (Azhar & Asce, 2011; Bernstein & Pittman, 2004; Cao et al., 2015), the findings of this study indicate that (BIM-specific) functional issues lead to employee resistance. Evidence can be found that there is low perceived usefulness and a general fear of BIM among the workforce. This anxiety and skepticism is related to the complexity and lack of understanding BIM in general (Newton & Chileshe, 2012). Moreover, the findings underline that resistance is triggered due to the incompatibility of different software programmes. This corresponds to Bernstein and Pittman (2005) who note that adopting new integrated technology is a challenge due to the coordination and interoperability of different software programmes among various involved disciplines. With regard to insufficient management support, the results of this study further confirm the widespread assumption (Arayici et al., 2011; Cao et al., 2015; McAdam, 2010; Young & Bernstein, 2008) that insufficient management support can be a pivotal barrier that could lead to employee resistance. Among others, the findings show that poor process integration, lack of technical expertise, lack of consistency, lack of (financial) rewards, and particularly the lack of clear standards and guidelines will lead to resistance to change. This supports previous studies, in which authors found that BIM-specific requirements still need to be adequately embedded in the current state of procurement and legal structures (McAdam, 2010) and that a lack of standardised guidelines and awareness will hinder successful technology adoption. As a result, the subsequent propositions can be suggested:

Proposition 6: *Functional barriers (e.g., low perceived usefulness, ease of use, lack of interoperability) and insufficient management support (e.g., lack of clear standards and guidelines, poor process integration, lack of internal technical expertise, lack of rewards) negatively influence the process of successful technology adoption.*

Management of Employee Resistance

The results of this study propose four overarching strategies (employee empowerment and involvement, a change agent with transformational leadership skills, constant and intensive management support, and interactive training) to mitigate the identified sources of resistance to technological change, which will be discussed below. Generally speaking, it can be said that current literature on OCM practices can be corroborated by the results, however, small nuances contradict or contribute to current literature.

First, the findings strengthen that employee involvement in decision-making processes and employee empowerment will be a key strategy to manage employee resistance to change, which was already found in many studies (Davis & Songer, 2009; Henderson & Ruikar, 2010; Kotter, 1996; Stouten et al., 2018; Venkatesh & Bala, 2008). Yet, the earlier-discussed generational barrier provides the foundation for expanding current OCM practices. The findings underline the importance of particularly involving older employees in the entire change process and valuing their competence by demanding their expertise and deliberately selecting experienced staff to test new (BIM) tools while requesting feedback. Evidence has been found that active involvement of older workers by testing new tools can counteract negative attitudes and resistant behaviour towards technology adoption, which can be explained by the fact that employees feel valued for their know-how and are proud to play an important role in the implementation process while minimising the fear of being replaced by technology (Cagliano et al., 2019). This can be related to the Social Exchange Theory, which involves the exchange of socio-emotional resources between a leader and his/her followers (Rezvani et al., 2016) and states that employees who feel supported and valued by the organisation have a favourable attitude towards a change event and show proactive behaviour that drives success (Gibney et al., 2009). In relation to this, recent literature has found further evidence that participation in decision-making is most strongly related to an employee's well-being (Uribetxebarria et al., 2021) and increases the extent to which they identify with and enjoy being part of the company, which ultimately leads to more loyalty towards the organisation (Knezović & Smajić, 2022). Therefore, the following proposition is suggested:

***Proposition 7**: Empowering and involving particularly older employees in the active change process supports employees' well-being and reduces resistance to using advanced technologies, ultimately leading to successful technological change.*

Second, it was found that a change agent possessing transformational leadership characteristics, which is strongly related to high EI, can reduce sources of employee resistance to technological change. Although a large body of research highlights the great importance of formally appointing a change agent to, among others, reduce resistance (Ahn et al., 2016; Jonathan & Westover, 2010; Lines et al., 2015; Lee & Yu, 2016; Radzi et al., 2019), limited literature can be found on what personality factors and competencies make an effective change agent. It was identified that an effective change agent must possess a range of leading qualities and non-technical skills. The results indicate that social skills, in form of, for example,

high EI, are more important than the technical competencies of the change agent to ensure that the person in charge can reduce sources of employee resistance. Among others, an effective change agent must be empathetic, have communication and problem-solving skills, be sensitive to uncertainties and dissatisfactions, must motivate and inspire employees, and have dynamic capabilities (sensing and seizing opportunities to promote a new technological solution in the right moments). Comparing these qualities with characteristics of different leadership styles, it can be identified that they closely resemble those of a transformational leader. A transformational leader inspires people and leads changes in an organisation's strategy, structure, and culture; moreover, a transformational leader is a strong role model, is value driven, is an effective communicator, considers the personal needs of employees, is enthusiastic and listens to all viewpoints to create a spirit of cooperation (Pawar, 2016). The findings also support the study of Van Dun & Kumar (2022, under review) who recently found that a transformational leadership style increases employees' acceptance of technology adoption. Consequently, this leads to the following proposition:

Proposition 8: *A change agent possessing transformational leadership characteristics can reduce sources of employee resistance, eventually increasing willingness to new technology adoption.*

In addition to the selection of the right change agent, the findings are consistent with previous literature (Davis & Songer, 2002; Erdogan, 2008; Henderson & Ruikar, 2010), which identified training and sufficient management support as common OCM practices. The study provides evidence that an interactive training approach, which focuses on practice and ensures a dynamic exchange between the participants and the trainer is a primary strategy to mitigate resistance among the workforce; this is in line with Lawluvy et al. (2022) who also identified training to be the most effective mitigating strategy. Lastly, constant and intensive management support was identified to be a key strategy to reduce employee resistance to technology adoption, which supports current literature (Davis & Songer, 2009; Henderson & Ruikar, 2010; Lawluvy et al., 2022; Venkatesh & Bala, 2008) that also already found that standardised guidelines, (financial) rewards, reduced workload and transparent information and education are constantly needed to increase employees' willingness accept technology adoption. Yet, the findings further show that employees especially desire to receive immediate and competent help from specialists whenever they face a problem, which adds nuance to the current literature. Ultimately, this leads to the following proposition:

Proposition 9: *An interactive training and practical approach, as well as constant and intensive management support (with specialiats as back-up), will mitigate sources of employee resistance, eventually leading to successful technology implementation.*

5.2 Practical Implications

The current study provides implications for effective technology implementation in the AEC industry and identifies methods for managing employee resistance to change.

First, the results emphasise forming a guiding coalition, consisting of a change agent and an external consultancy firm, that possesses a range of social skills. Hence, in selecting a guiding coalition, industry practitioners must emphasise non-technical skills, meaning lower levels need to be involved in decision-making processes and the guiding team must have empathic skills and provide social support (e.g., recognising and addressing uncertainties, listening to and solving problems, motivating) to boost willingness to change.

Second, the guiding coalition must develop a compelling vision and corresponding objectives. To foster employees' acceptance of technological change, it is strongly advised to communicate *why* the specific objectives want to be achieved, e.g., in multiple information events and continuously updated intranet reports. Prior to the implementation, it is suggested to create a roadmap, in which the individual goals are prioritised to ensure timely implementation and set various milestones.

Third, given the disruptive nature of the technology, practitioners must provide interactive training that focuses on practice by immediately working *in* the model and ensuring a dynamic exchange between the participants and the trainer. In addition, the group size should be limited to a maximum of ten people to assure individual learning and commitment.

Fourth, it is strongly advised to continuously monitor and support the change process and not lose energy towards the end of the implementation. Development boards are helpful to monitor the different phases and keep the process driving. Moreover, intermediate control bodies need to be introduced to control the generated data in the different working stages, before they are passed on to the next working stage. It is also advised to offer continuous assistance through specialists. In addition, it is crucial to take a fundamental decision either for or against the use of the new technology to avoid the usage of two parallel software systems. Top and middle management must exude continuity and be enthusiastic about the new vision and live the new norms and values to make the change authentic.

Fifth, to manage employee resistance, it is crucial to turn those affected by the change into participants, i.e., it is advised to actively involve lower layers in the change process, e.g., by letting them test new tools and demand their feedback. It is suggested to involve especially the older (more resistant) generation in the implementation process by slowly introducing them to the new technology and asking for their feedback; this conveys appreciation for their long-standing knowledge while minimising loss of human labour status and job insecurities.

Sixth, the management must establish well-defined standards and guidelines by creating clear one-pagers, for example. Moreover, the workload needs to be reduced so that employees have enough time to learn the new programme by taking employees out of other projects. In addition, the right amount of pressure should be applied by finding the right balance between trusting staff to act on their own and pushing the change process forward in necessary moments. Lastly, it is suggested to (financially) reward the extra effort of employees to create (monetary) incentives.

5.3 Limitations and Future Research

As in all research, this thesis is also not without limitations. Firstly, given the specificity of this research and its focus on implementing BIM in the AEC industry, it is unlikely that the results are generalisable to a broader population. Yet, the findings offer specific insights that could be helpful for other companies with characteristics similar to the ones presented in this thesis, and future research could consider exploring a similar topic but in other industries.

Secondly, the sample size was 18 respondents, which is a reasonable number for qualitative research, but mostly with participants from the northwest of Germany, a country characterised by a rather masculine culture. Although future researchers need to be aware that the German culture does not have a noticeable impact on the results, but rather that it is the industry that has its own culture, for the sake of completeness, future research could expand the demographics of the sample population and include broader geographical regions of Germany. In addition, the study did not control for social desirability bias and selection bias. Therefore, future research should use control measures to reduce these forms of bias.

Thirdly, by limiting the study focus to internal resistance, external resistance was only briefly touched upon. However, future research could further explore the aggregate dimension “external resistance of business partners”. Since BIM is more likely to be implemented by larger construction companies, it is suggested to investigate smaller-medium-sized companies that have not yet adopted BIM to identify underlying reasons why they show general resistance to technology adoption.

In relation to the above, the fourth limitation of this work is that just one major implementation barrier, namely employee resistance, was studied. Yet, it is known that many other barriers might occur when implementing a disruptive high-tech innovation in the AEC industry, such as, for instance, cost and time barriers. Moreover, in addition to resistance, there are also other (positive) attitudes to technology adoption, such as proactivity, acceptance and disengagement (Oreg et al. 2018). Future research might investigate other barriers and emotional episodes that may occur when adopting technology to complement the CM literature in this specific context.

In addition, this study is limited to the implementation of the 3D business software BIM. It is known that the research had a very specific focus on a rather new, high-tech, and disruptive innovation, which might create immense staff resistance. However, there are other CAD innovations yet to be studied in terms of their implementation and the extent of employee resistance. Future research should investigate the implementation of less disruptive and impactful technology, with special regard to resistance. In this context, the study suggests that the more high-tech a technological solution is, the more training is required to adopt new technology, providing fertile ground for future research.

Lastly, given the nature of this work, which is purely qualitative, future research might consider involving a quantitative study but also a longitudinal study to follow the entire process of technology adoption.

6. Conclusion

This study aimed to create a viable basis for a BIM strategy and guidance for its implementation based on popular OCM models. In addition, sources of employee resistance, as well as appropriate methods for managing resistance to technology adoption in the German AEC industry, were to be identified.

The findings show that current OCM models need to be slightly modified in the given context of technology adoption. More specifically, the selection of a guiding coalition, consisting of an effective change agent and an external consultancy, with a high EI is a key factor for successfully steering the introduction of new technology in the AEC branch. It was identified that social skills are at least as important as technical skills when implementing a new technological solution. Moreover, due to the traditional nature of the industry and the complexity of the technology itself, the study found that an equal amount of effort needs to be spent to all phases to ensure that the change is institutionalised. Therefore, among others, employees must be inspired and motivated for the technological change by emphasising an interactive training approach that focuses on practice and ensures a dynamic exchange between the participants and the workshop trainer.

The results further indicate that generational barriers have the greatest impact on employees' resistance to new technology adoption. This is followed by functional barriers and insufficient management support, which causes negative reactions from employees. In accordance with the identified sources of resistance, empowerment and involvement of (especially older) employees, a change agent with transformational leadership skills, constant and intensive management support, as well as an interactive training approach proved to be most effective in mitigating and overcoming reasons for employee resistance.

In summary, a new technological solution (BIM) represents a paradigm shift for the entire AEC industry, which requires comprehensive implementation planning, careful staff selection, interactive and practical training, and special attention to older generations.

In line with these considerations, this thesis is concluded with the following quote:

"Technology is just a tool. In terms of getting the kids working together and motivating them, the teacher is most important." (Bill Gates)

7. References

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8. Appendix

8.1 Interview Guides for Managers and Employees

The objective of this study, which is conducted as part of my Master Thesis at the University of Twente, is to investigate the implementation process of the business software programme BIM. Thereby, the phenomenon of employee resistance to organisational change will be investigated in depth.

Previous questionnaire

Participant	**Age Gender Position Years of experience in Department current position**
A B …	

Interview questions for change managers

Themes	**Follow-up questions**	**Probing questions**
Introductory questions		
Could you tell me something about your job function?	What was/is your role in the technology implementation process?	What where the expected benefits of the change process BIM Definition!!?
How were the changes communicated to the staff?	How was this received by the employees? And why?	Why do you think the employees reacted the way they did?
What challenges did you perceive during the implementation process?	What specific challenges did you experience regarding your employees?	Can you give me an example?
Main Part		
What strategies did you use to convince employees of the BIM implementation?	What specific practices did you use to prepare your employees for the change?	Can you tell me more about it how you created trust in the change?
What were the first reactions of the employees when they heard about the implementation of BIM and the related organisational changes?	How has their reaction been reflected in their behaviour?	Why do you think, they reacted the way they did? Can you give me an example?
In your opinion, what do you think were the biggest concerns against or the main arguments for the introduction of BIM among your employees?	How did your employees' concerns become apparent? Did they express their concerns openly or covertly?	Why do you think these where the biggest concerns?

How did you respond to concerned employees?	That's interesting. Can you give me an example of a concerned employee?	How did you approach even the quietest employees to raise their voice?
What did you do to reinforce/manifest the change?	Why do you think employees always fall back into old habits?	How do you deal with employees who still show resistance?
Review		
If you could start all over again, what would you differently regarding the implementation process?	Why would you do it differently?	How would you do it?
Outlook		
In case you would like to add anything later, this will be possible. Personal data will be anonymised during the transcription of the audio file.		

Interview questions for employees

Themes	**Follow-up questions**	**Probing questions**
Introductory questions		
Could you tell me something about your current job function?	Which tasks do/did you have to learn a new?	To what extent has it affected your day-to-day work?
Main part		
What was your first reaction when you heard about the implementation of BIM and the related organisational changes?	How has your reaction been reflected in your behaviour?	Why did you react like that? Can you tell me more about your feelings?
How did the responsible person(s) communicate the change?	How did it make you feel?	Why did it make you feel like that?
What is/was your biggest concern?	How do/did you deal with your concerns?	Interesting, can you tell me why?
How have managers tried to convince you that the change is necessary?	Why did it (not) work?	What would have been necessary to convince you?
Do/did you communicate your concerns?	If so, how do/did you communicate your concerns and why did you (not) communicate it?	How do/did the managers deal with your concerns?
What methods were used to ensure an effective preparation for the change?	To what extent have these methods helped to reduce your concerns?	Why do you think these methods reduced your concerns?

To what extent were the change agents helpful?	Why (not) did you think the change agents were competent?	What could they have done better?
What is your opinion about the implementation of BIM right now?	Are there still any concerns?	What are the concerns?
Review		
In your opinion, what would you do differently in implementing the change?	How would you do it differently?	Could you give an example?
Outlook		
In case you would like to add anything later, this will be possible. Personal data will be anonymised during the transcription of the audio file.	If you have an idea of how to improve the interview questions, I would be very thankful if you could share your thoughts with me.	