ARGUMENT MAPPING OF THE PROPOSED BENEFITS OF AGILITY AND AGILE PRACTICE ADOPTION IN CONSTRUCTION PROJECTS

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Some agile methods and practices have been argued to have potential benefits for construction, but those arguments have not been analysed critically. Argument mapping analysis, based on the Toulmin (1958) model of argument, is used to examine how research has constructed arguments about the benefits of agility in construction and whether the adopted agile practices have met the proposed benefits. Results showed that pro-agile arguments were constructed around flexibly responding to changes in construction management. However, some of these lack empirical evidence. Organisational and project-level barriers to agile adoption were claimed in con-agile arguments. Studies also showed negative attitudes towards agile practice adoption and resistance to the pro-agile arguments. Findings are relevant to construction managers considering agile solutions for better performance. In addition, identifying how claims surrounding agile are constructed can also lead to an evaluation of the influence of these accounts on researchers and practitioners.

Keywords: agile supply chain; agile methods; agility; management

INTRODUCTION

Construction projects are characterised by complexity and rigid, irreversible schedules (Ribeiro and Fernandes 2010). COVID-19 pandemic implied that it is time for construction industry to think about resilience capabilities and to question about what may be considered 'matter of fact' ideas in construction management to remain competitive in the post-covid environment. Construction firms should not be satisfied with 'what we know' as unanticipated changes continue to challenge construction projects, but to establish ideas on 'where we should go' in the future in a resilient and sustainable way (Abu Hammour and Abuhammour 2020).

Agility describes the ability to cope with unanticipated changes in a timely manner (Conboy 2009). In the construction environment, agility has been argued as the ability to have flexible and on time responses to customer requirements and project environment changes, which if ignored will lead to cost burdens, project delays and even rework (Saini, Arif and Kulonda 2018). To build up agility in construction firms and projects, some ‘agile’ methods and practices have been applied in construction management (Mostafa, Chileshe and Abdelhamid 2016, Suresh, Roobaswathiny and

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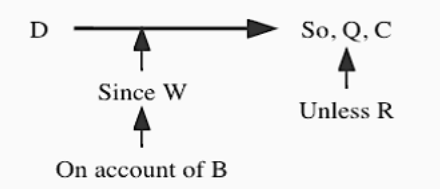
Lakshmi Priyadarsini 2021, Zender and de Soto 2021). Agile supply chain, agile software development, and agile project management were all mentioned to have potential in construction.

However, by reviewing literature upon this topic, it is found that some arguments related to benefits of 'agile' practices in construction are based on rhetorical persuasion rather than enough supporting evidence. Based on Toulmin (1958) theory of informal logic and argument model, argument mapping is a useful analytical tool for researchers to summarize arguments and to examine the structure of arguments and the degree to accept the argument as a reader. Argument mapping analysis is used in the paper to examine how the research constructed arguments about benefits of agile practices whether the proposed benefits have been met. The analysis generated a clear map of existing arguments on topics around agility and agile practices in construction, which critically points out information that may be overlooked in a more general literature review, including the status of adoption, unsupported arguments, and potential benefits and exception conditions of using agile practices in construction projects.

Theoretical Framework

Based on Toulmin (1958) theory of informal logic, arguments are rhetorical acts in a proper form of components, like an organism, and are persuading in nature. The basic form of an argument can be seen as 'given the data D, so C'. As arguments are tended to persuade or convince people, the basic form of argument needs to be enriched with more information to achieve that purpose (see Figure 1). To explain the relationship between the data(D) and the claim(C), warrant(W) has been inserted to implicitly link the logic as a bridge. Backing(B) is the relations or conditions that explains the warrant(B). The claim (C) may not be certain in every circumstance so the degree of force which the data confer on the claim need to add to the model, as qualifier(Q). The condition of exception is called Rebuttal(R).

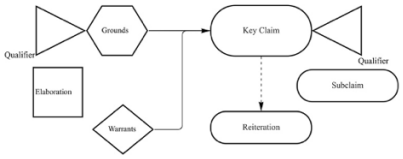
Figure 1: Toulmin (1958) model of argument



Fletcher and Huff (1990b) adapted the model by excluding backing because they believed in practical, it is hard to differ between warrants and backings. Also, they identified three subordinate elements to the model of argument, which are Elaborations (clarifying statements for all components), Subclaims (subordinate claims dependent on the acceptance of the claim), and Reiterations (restatements of the claim). Fletcher and Huff (1990a) classified claims and warrants into categories based on purpose of a claim or a warrant and generated a flow chart diagram to illustrate their adapted model of argument (see Figure 2).

The paper adapted the model to a simplifier diagram (see Figure 3). Reiterations and elaborations are excluded in the analysis because the research topic is relatively new and limited to a small number of materials. Also, the relationship between key claims and reiterations is out of analysis scope and hard to detect.

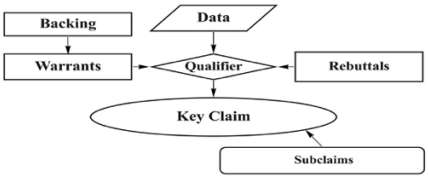
Figure 2: Fletcher and Huff (1990a) flow chart model



The explanations of components followed Fletcher and Huff (1990a) and Hirschheim, Murungi and Peña (2012), including:

- Key claims: a claim is a statement put forward for the audience to believe
- Data: evidence produced in support of a claim
- Warrants: logical connection between claim and data
- Qualifiers: the degree to accept the key claims are true
- Rebuttals: potential objections or exceptions to accept the key claims are true
- Backing: relations or conditions that help explaining the warrant
- Subclaims: subordinate claims dependent on the acceptance of the claim

Figure 3: adapted model of argument



METHOD

The argument mapping analysis used Scopus as search engine and database in data collection. The process of data collection followed steps in Fletcher and Huff (1990a). Microsoft Excel, Endnote 20, and Miro provided technological help on organizing the electronical files and coding the text extracted from the selected literature.

Literature identification and marking: A rigorous search on related literature was conducted by using Scopus database, which has the most comprehensive coverage on peer-reviewed articles and guarantees the quality of the searched papers (Paul, *et al.,* 2021). The search string was set as: TITLE-ABS-KEY ("agile" AND "construction"). 113 articles returned from the search (saved in the Excel sheet) and went through a quality check on the research area and availability of full paper. Finally, 17 articles were selected for the next step coding. Full papers were archived to Endnote 20 and a full-text content analysis was conducted focusing on extracting the components of arguments made in the article. Highlights were made on the articles marking out the components of arguments.

Entry of the text of the components on the coding sheets: For each selected article, the adapted model of argument (see Figure 3) was constructed in a separate online whiteboard provided by Miro. The highlighted text of the components of arguments were coded at the adapted model on online whiteboards.

Data analysis: On the online whiteboard, components of arguments extracted were linked to other components and rechecked the relationship with original discourse in the literature. Arguments that inside the selected articles but are secondary to the research topic were excluded. In total, 15 models of arguments were set up in 15

online whiteboards. Components of arguments in each whiteboard were then mapped to an overall diagram and grouped around 'pro-agile claims' and 'against-agile claims' for cross analysis and discussion.

FINDINGS

Existing problems of construction industry served as Backing in the argument model which can be considered as background of the arguments around agile and construction. Fragmentation and complexity were seen as two major factors in the poor construction performance (Ribeiro and Fernandes 2010). These factors offered both opportunities and barriers to adoption of agile practices in construction management. Ribeiro and Fernandes (2010) noted that fragmentation was caused by industry structure, which 99% construction companies are SMEs and SMEs are characterised with fragile business, less completable and lack of management capabilities compared with big companies. On the other hand, construction projects need to mitigate risks through clear divisions of responsibility and procedures, which caused complexity in planning and executing (Schwarts and Amaba 2017).

Another backing of the argument is the understandings of agility in management area. In 1950s, agility was used to describe an aircraft's ability to manoeuvre state or as the time derivative of manoeuvrability in the field of air combat (Breu, *et al.,* 2002). With the development of manufacturing industry in 1980s, agility was popularized in manufacturing and supply chain management. After entering the era of Internet, agility was spread quickly in information technology areas as a new methodology of managing software development and engineering projects. The success of some agile software development methods in project management, for example Scrum and Extreme Programming, attracted many agile users in 2000s (Chow and Cao 2008, Pikkarainen, *et al.,* 2012). The scope of 'Agile' application had been expanded to industries and projects other than software development in 2010s onwards (Conforto, *et al.,* 2014, Zender and de Soto 2021).

1. Responsiveness and adaptive

'Agile' contains the meaning to be responsive in business activities (Brennan, *et al.,* 2015, Holweg 2005). The focus on response to change had been continuously discussed and emphasized. Shafer, *et al.,* (2001) believed that agile was nimble and change-hearty. This idea had also been discussed by the famous Agility Forum in 1994. The Agility Forum regulated the time frame for acting agile, which means that response need to be performed in a useful and timely manner (Goldman, Nagel and Preiss 1994).

2. Flexible and speed

Flexibility and speed are always linked when talking about 'agile' in organisations (Jin 2004). This view closely followed the Prater, Biehl and Smith (2001) viewpoint. Speed means that agility is based on quick response ideas (Fayezi, Zutshi and O'Loughlin 2015) and agile organisation system is to make sense quickly, make decisions nimbly and redeploy resources rapidly (Brueller, Carmeli and Drori 2014).

3. Collaboration

Agility related closely with collaboration. Collaborative forecasting partnerships bring better information, improved decision support technologies and process improvement to the trading partners, thus result in the increased agility (Aviv 2007). Gunasekaran, Lai and Cheng (2008) stated that agile manufacturing relies on the strategic alliance and partnerships in achieving speed and flexibility. Relationship

integration has strong impacts on the supply chain agility and flexibility development (Fayezi and Zomorrodi 2015).

4. Iterative and incremental

In publications after 2000s, the understanding of 'agile' as an iterative and incremental method largely increased. The reason lies in the popularity of Agile Manifesto at 2000s in software development and information system industries (Beck, *et al.,* 2001). Agile methods were constructed based on an idea of iteration, which means the software was developed by iterations and each iteration includes phases from planning to delivery (Abbas, Gravell and Wills 2008).

Some research argued that agile software development methods or agile supply chain positively led to agility and have potential benefits for construction management. For example, Gibson (2018) argued that firms who want to compete in dynamic markets need to build more agile operations and Hardie (2016) argued that construction SMEs have more agility factors to trigger innovation. The related claims, warrants and data were extracted and analysed to show the logic of arguing in this section (See Figure 4).

Some claims were argued with evidence from the field. Frutos and Borenstein (2003) designed an object-oriented model for mass customisation in building projects and argued as to provide agile interactions between customer and building companies. They built up the claim based on the logic of by increasing flexible interactions between customer and building company, the total customisation time and cost would decrease, user satisfaction would increase, and companies would gain more knowledge about customer preferences that would help new projects. Data came from a field test of a Brazil residential project got good result on using the model for six months (Frutos and Borenstein 2003). Carlos and Amaral (2018) claimed on continuous roadmap updating that incorporates agile principles supports construction planning and evidence from action research validated agile principles positively impacted on managing roadmap in construction projects.

However, some claims were weakly argued and lack supporting evidence to convince readers. For example, Martek and Chen (2015) researched on procurement strategy of foreign constructors in China and case study showed that one international construction firm using agile procurement strategy in managing their supplier relationships in China, which in this paper, 'agile' means the firm does not hold permanent linkages with up-stream supplier. The finding cannot lead to a claim on benefits of agile thinking adoption in construction since the performance information of the mentioned company was not provided in the paper. The finding only implies there is a view in research that a flexible procurement strategy can be seen as 'agile'.

Hardie (2016) claimed that construction SMEs have more agility in innovation and warrants came from characteristics of SMEs that containing less bureaucratic, more skilful individuals and potential to partnership with other SMEs. The author used 10 case studies on Australian construction SMEs that showed more proactive responses to changing circumstances to support the claim. However, the rebuttals also came from characteristics of SMEs. SMEs have less financial space to plan and innovation for change. Since there are many SMEs, companies encountered high level of competition, but they are less able to monitor their competitors. In terms of business goals, SMEs may want to survive rather than to grow.

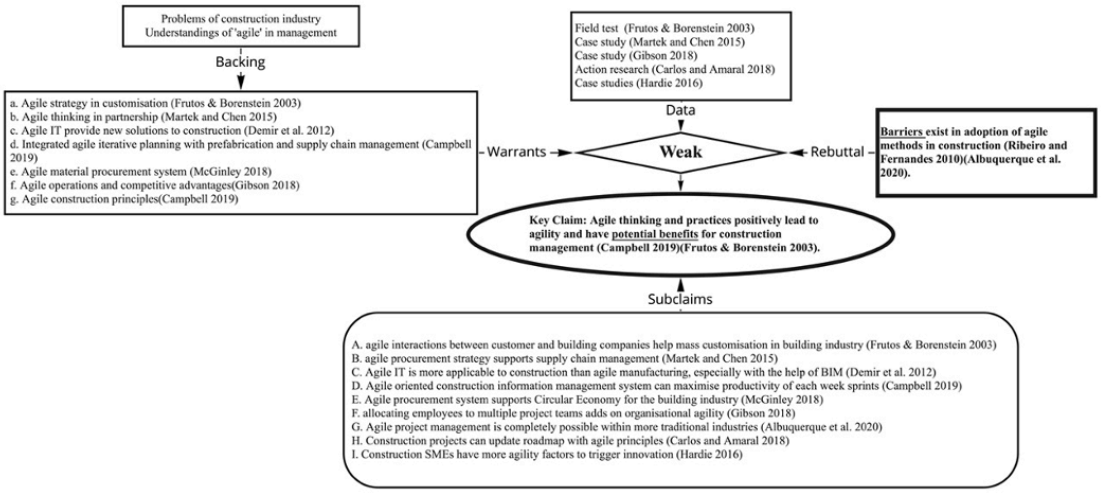


Figure 4: Model of pro-agile arguments

McGinley (2018) termed agile circular economy and argued that agile procurement of used materials in construction projects supports circular economy. An agile material system was structured in the paper using software development method to search for BIM required materials on eBay. The most obvious limitation of the argument is it has not been tested in field, so no data or evidence was provided to support the argument.

Gibson (2018) argued that multiple team membership increased organisational agility, but the data on a case study showed an inverted U shape relationship between multiple project teams and project delivery, which means when there are too many teams that have multiple team membership, the performance will decrease. Thus, the argument is not convincing to readers since conditions and relationship is not clear in the claim.

Campbell (2019) developed a construction information system model with iterative planning method and prefabrication in supply chain management. Agile software development methods were argued as more applicable to construction environments than agile supply chain thinking as agile software development methods provided practical solutions to construction such as iterative planning with the help of IT system (Demir, *et al.,* 2012). The agile information management system proposed by Campbell (2019) was claimed to improve the resilience and productivity of residential construction projects, but no empirical validation was provided in the paper to support the claim.

In sum, some claims on benefits of agile in construction management were only argued with theoretical explanations and were not mapped with empirical evidence. Lack of evidence can be viewed as research gap in this area that if good results are achieved in future empirical research, the convincing level of the pro-agility claims will increase correspondingly. For example, a case study on performance appraisal of a construction project, which adopted McGinley (2018) model of agile material system, would examine the benefits of agile procurement on circular economy and give readers more data to accept or reject the claim. Methodologically, longitudinal study on an agile adoption in construction project with triangular data would improve the convincing level of the pro-agile claims more than a quantitative survey on construction managers' attitude of agile practice adoption. The reason is that since people's understanding of agile is different and the complexity in construction projects

makes it hard to ensure that people in different construction jobs understand agile-related concepts in a correct perspective in each survey question.

Claims on barriers existed in adoption of agile methods in construction were Rebuttals to pro-agility arguments and evidenced with empirical analysis results (see Figure 5). No direct adoption of agile practices shown in the case studies in Ribeiro and Fernandes (2010) and interviewees were aware of value of agility but their attitudes towards agile practices were negative (Albuquerque, Torres and Berssaneti 2020).

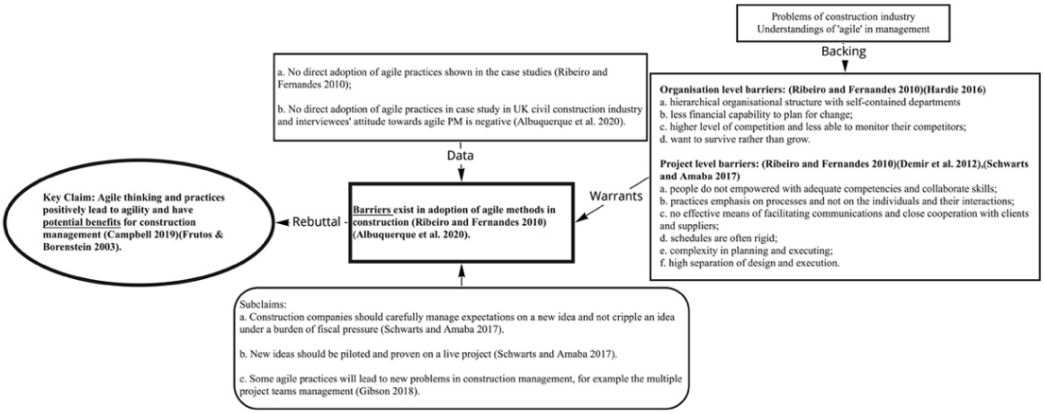


Figure 5: Model of con-agile arguments

SMEs occupied a large percent of construction industry, who have less financial capability to plan for change and suffered with higher level of competition, that turned the SME to strategically focus more on survive other than grow (Hardie 2016). Big construction firms do not have those concerns, but their hierarchical organisational structure and self-contained departments can easily have more resistance to change (Ribeiro and Fernandes 2010). In project level, less empowered people, and no effective means on solving the classic construction problems (rigid schedule and poor communication) were demonstrated as logic relationship that explains the phenomenon observed from the case studies (Demir, *et al.,* 2012, Ribeiro and Fernandes 2010).

Subclaims under this research stream advocated that construction firms need to carefully manage the expectations on a new idea to avoid further cost burden on the adoption of new idea. Pilot project is useful approach for construction firms to test the new method or practice (Albuquerque, Torres and Berssaneti 2020). Also, some agile practices may cause new problem in construction management, for example, Gibson (2018) argued that multiple team membership could increase organisational agility, but this research also noted that teams with temporary stuff who have multiple memberships will be more fragile in management.

In all, the argument mapping of both pro-agile claims and con-agile claims were constructed (see Figure 6). The proposed benefits of agile thinking, including practices originating from agile manufacturing and agile software development, were the most relied upon for pro-agile arguments by researchers.

However, the Qualifier (the degree of accepting the pro-agile arguments as true) is affected by lack of supporting evidence and the Rebuttals (barriers of adoption noted in the literature). Given the fact that some of those arguments were only constructed at a conceptual level with rhetorical explanations rather than supporting evidence, it is likely to infer those researchers were trying to influence the reader opinion of agile,

which is fundamental to creating a management fashion for agile concepts in construction management.

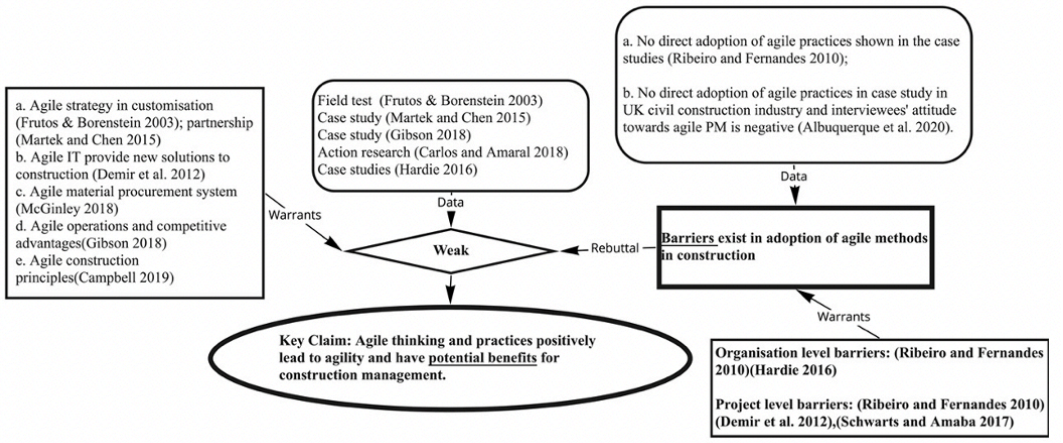


Figure 6: Integrated model of arguments

Moreover, some studies had conceptual discussions on benefits of agile practices, but their empirical analysis showed no adoption in practice. Barriers of adoption were also claimed in existing research. Organisational and project-level barriers were noted as explanations of the claim and evidence of no existing adoption in case studies supported the claim that construction firms should properly manage their expectations of innovative ideas such as agile adoption.

CONCLUSIONS

Construction firms are faced with more challenges in the post-COVID-19 period with changing customer requirements and external environment, which leads to the need for increasing resilience capabilities and thinking about where construction projects should go in the future. Agility as a capability to flexibly respond to changes was noted in construction research and agile related practices, transferred from agile supply chain and agile software development, which have been argued as have potential benefits. However, an argument mapping analysis shows that some of the benefits claimed in the research lack supporting evidence, which in turn lowered the degree of convincingness of the proposed benefits to readers. Barriers to adoption of agile practices in construction have been noted in research with some negative attitude from industry. Critically, this argument mapping results implies that both pro-agile and con-agile arguments call for future research in theoretical relationship analyses of agile practices and construction problems, empirical research on validating the proposed agile framework and models in construction projects. Construction researchers need to put more effort on questioning and demanding validations on 'matter of fact' things or ideas rather than following and arguing management fashion. Managers in construction, who wish benefits from agile practices, should be aware of the barriers and consider a pilot project before large-scale adoption of new agile practices.

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