

1           **Exploring individual adaptability as a prerequisite for**  
2           **adjusting to technological changes in construction**

3           Derek Asante Abankwa<sup>1</sup>, Rita Yi Man Li<sup>2</sup>, Steve Rowlinson<sup>1</sup> and Yadi Li<sup>1</sup>

4           <sup>1</sup> Department of Real Estate and Construction, The University of Hong Kong, Hong Kong

5           <sup>2</sup> Sustainable Real Estate Research Center, Hong Kong Shue Yan University, North Point,  
6           Hong Kong  
7           derekpg@connect.hku.hk

8           **Abstract.** The advances in globalisation and technology have had significant  
9           impacts on the work environment, as they make various jobs more dynamic and  
10          fast-paced. Adaptive employees have become essential ingredients for  
11          organisations' success. Changing technologies such as digital transformation and  
12          automation require employees to adapt to new ways of working. This study  
13          considers the reactive approach of individual adaptability, which is seen as  
14          modifying one's behaviour to meet the demands of a new situation, event or a  
15          changing environment. Other definitions suggest that adaptive performance can  
16          be proactive to the anticipated future changes in the environment. The study  
17          employed an exploratory research approach to understand the concept of  
18          individual adaptability to technological changes in construction organisations. It  
19          involved semi-structured in-depth interviews with three top management  
20          professionals and four construction workers from four different firms. These  
21          organisations were selected based on their number of employees, main  
22          construction business as contractors, and investments towards technological  
23          changes. The findings indicated that individual adaptability is a performance  
24          construct instead of a personal characteristic. Workers are not involved in the  
25          decision-making processes regarding technological changes. Furthermore, the  
26          difficulties in implementing technological changes mainly consist of changing  
27          the mindset of workers who have used the same method for a long time and a  
28          lack of investment in innovation methods. The study identifies leadership,  
29          experience and open-mindedness as the predictors of adaptation to new  
30          technology. Workers consider learning through training as adaptive behaviour in  
31          technologically advanced environments. We propose future empirical studies on  
32          adaptability and trainability.

33          **Keywords:** Adaptive Behaviours, Technological Change, Exploratory Study.

34          **1 Introduction**

35          Modular construction shall be an indispensable part of the construction industry in the  
36          future. The construction industry is currently driving towards technological  
37          advancements with digital technology which, when adopted during projects, reduce  
38          errors, save cost and time and increase client satisfaction. These change the traditional

39 methods of construction amongst construction workers. However, regulations and  
40 existing attitudes about how the industry has always done things present powerful  
41 inertial forces for stakeholders. Adaptability is considered as a necessary skill when we  
42 face changes. There is a lack of studies regarding construction personnel's adaptability  
43 and the understanding of employees' adaptation [1], which drives the motive of this  
44 research. To understand the individuals' ability to adapt to change, the study considers  
45 predictors of adaptability (predictor space), dimensions of adaptability (criterion space)  
46 and the relationship linking both spaces. This exploratory study was undertaken to  
47 understand the characteristics and behaviours of individuals, especially during  
48 technological changes in the construction context. Such knowledge is crucial for  
49 organisations which intend to implement change to know of possible pitfalls.

## 50 **2 Propositions of Individual Adaptability (I-ADAPT) theory**

51 Individual adaptability is the process by which an individual achieves some degree of  
52 fit between his/her behaviours and the new demands created by the novel and often ill-  
53 defined problems resulting from changing situations [2]. It has been considered in task  
54 performance that adaptability involves changes to cognitive processing, coping and  
55 adapting to organisational change. The study of individual adaptability leads to the  
56 development of the I-ADAPT theory, which integrates all the various dimensions of  
57 adaptability by providing a discussion of individual differences with a network of  
58 Knowledge, Skill, Ability, Other characteristics (KSAO)-performance relationships.  
59 Individual adaptability involves both the 'will do' (personality) and 'can do' (ability)  
60 characteristics. Chan [3] indicated that the 'can do' and 'will do' characteristics are  
61 essential for excellent performance in jobs which require high levels of adaptation.  
62 However, when 'can do' is lacking, more 'will do' leads to a poorer performance  
63 outcome than less 'will do'. Having a 'will do' attitude may be adaptive/maladaptive,  
64 depending on whether one is high/low on 'can do'. The theory makes no specific claims  
65 about the nature of performance. When individuals perceive the need for change in a  
66 no-change environment, adaptability is often proactive, but when change is dynamic  
67 and frequent, adaptability is reactive.

68 This study focuses on technological advancements as the changing situations in the  
69 environment. The reactive nature of adaptability is due to the frequent changes in  
70 technology. The I-ADAPT theory posits that the environment drives the performance  
71 requirements of adaptability. If the situation requires adaptation, any dimension of  
72 performance is determined by individual differences in adaptability.

## 73 **3 Technological Changes**

74 Technology is often considered as either hardware or software that support the  
75 transformation of inputs into outputs in an organisation's processes. The introduction  
76 of new technological processes has been identified as an enabler of efficient  
77 improvements, cost reductions in production and R&D [4]. Technology needs to be  
78 acquired or developed internally and must fit the context in which it is implemented

79 [5]. Such changes invoke equivocality, as well as technological, financial and social  
80 uncertainty, since the technology, in its initial stage, is not well understood [6].  
81 Technological change is a loose concept that has many meanings depending on the  
82 discipline. Changes in technology refer to a) new technological inventions-tools,  
83 facilities, services and their variations in society; and b) new production techniques and  
84 the introduction of new methods of production. The difference between a) and b) is the  
85 distinction between process and product technology. However, process and product  
86 technology are often used interchangeably. There are some similarities between  
87 changes in process and changes in a product, because the new process might require  
88 some product change, and product change might also involve some elements of a new  
89 process. New technologies comprise materials and components which can be combined  
90 to produce an overall working system which includes elements such as skills and  
91 abilities (patterns of behaviour) necessary to operate the said technologies.

92 The study does not focus on product technology per se since there are many products  
93 which require several KSAO determinants. For instance, the KSAOs needed for  
94 operating drones might not be the same as those required for BIM. The study, therefore,  
95 focuses on technological processes.

## 96 **4 Methods**

97 The purpose of this study is to gain an understanding of how individuals adjust to  
98 technological changes in organisations. There is little research available regarding the  
99 industry's perception of adaptive behaviours towards technological changes in  
100 construction research. Cooper [7] cemented the use of the exploratory approach in  
101 research with limited information available, but the researcher wishes to have the  
102 flexibility to conduct future exploration.

103 The I-ADAPT theory provides the theoretical framework for this study since it  
104 aggregates predictors and behaviours in an adaptive environment. It was also used to  
105 guide the data collection, analysis and discussion of findings. The constructs employed  
106 were initially discussed with academic peers and construction practitioners to increase  
107 the validity of the work. An exploratory study may not have a rigorous methodology,  
108 as used in conclusive studies, and sample sizes may be smaller [8]. Therefore, the study  
109 rests on seven semi-structured, face-to-face in-depth expert interviews. Three  
110 interviews were conducted with employees at the management level of their  
111 organisations who were responsible for implementing changes in their organisation.  
112 The other four were construction operatives who were required to navigate the  
113 processes of technological changes successfully. The purpose of this was to capture  
114 respective experiences with implementing and adapting to technological changes. The  
115 interviewees were purposively selected from four contractor organisations in Hong  
116 Kong with strong technological competences and which make substantial investments  
117 in technology. These organisations have hierarchical structures and departments that  
118 impede flexibility, making the environment challenging for process development and  
119 implementation. Purposive selection increases the chances of capturing valid insights.  
120 We collected ten hours of recorded interview data. Interviews focused on the

121 respondents' experiences with implementing technological changes at the management  
 122 level and adapting to these changes at the operations level. Interview transcripts were  
 123 coded based on the categories of the I-ADAPT theoretical framework. The purpose of  
 124 this measure was to identify adaptive behaviours employed by operatives during  
 125 changes in technological processes and to establish the antecedents of their adaptability.

126 **Table 1.** The details of the participants.

<b>Participant / Years of experience</b>	<b>Role and Academic background</b>	<b>Technological changes</b>
Interviewee 1 (TM1) (12 years)	Engineering Manager (BSc, MSc, Chartered Professional Exam)	ProjectWise, Microsoft Share Point, BIM, Engineering Management Systems
Interviewee 2 (TM2) (22 years)	Engineering Director for Digital transformation, innovation and virtual construction (BSc, MSc)	Sensors and Trackers, Digital environment
Interviewee 3 (TM3) (4 years)	Innovation Catalyst (BSc, MSc)	Yammer
Interviewee 4 (OP4) (4 years)	Site Engineer/Technical works designer (BSc, MSc)	RFID real-time monitoring, Photogrammetric Technology, Modular Integrative Construction
Interviewee 5 (OP5) (7 years)	Project Engineer - Operations team member (BSc)	Temporary reclamation, Google Sketcher
Interviewee 6 (OP6) (4 years)	Planning Engineer (BSc, MSc)	SynchroPro
Interviewee 7 (OP7) (5 years)	Operations Engineer	Automatic Detection System

127 \*TM: Top management, OP: Operatives

## 128 **5 Findings and Discussion**

### 129 **5.1 Management Level**

#### 130 **Causes of technological changes in processes**

131 The most important thing was that all interviewees agreed that there is a need for change  
 132 in the construction industry by employing new ways of undertaking work activities.  
 133 However, interviewees saw change as a challenging event. Changes are likely to be  
 134 caused by different sources at any stage in the organisation. In construction, the source  
 135 of technological changes comes from either inside or outside the organisation, as  
 136 highlighted by TM1 and TM3, which makes managing change very difficult.

137 TM1: *It comes from people; it comes from materials, supplies, and site conditions.*  
 138 *All sorts of things. I would say the reason why we struggle with change or why change*

139 *happens most of the time, though, is poor preparation and poor planning. People think*  
140 *that they have a plan or routine, but it is not until they start to deliver or do it that they*  
141 *realise this might not work; I need to change the product or process.'*

142 TM3: *'The minimum is defined from the client's side in the contract, but they don't*  
143 *care about your day-to-day change, they care about changes in formal submissions. If*  
144 *clients ask for the change in technology, then you must do it. If they don't ask for it,*  
145 *then it's harder to get the adoption. The clients' requirements are a driver towards the*  
146 *new technology.'*

147 Construction organisations should change without external influences such as  
148 waiting on clients to suggest technological changes. Being able to assess the  
149 environment and identify relevant cues that require change falls under the proactive  
150 dimension of adaptability. Technological changes in construction demand a reactive  
151 approach of adaptability rather than one which is proactive in nature.

### 152 **Implementing technological change in processes**

153 None of the top management interviewees had specific procedures regarding  
154 technological changes adaptation. They depended on the understanding and skills of  
155 their subordinates. According to TM2, their organisation gives everyone an  
156 understanding of the technology by implementing it in a project. The workers are then  
157 asked to provide both onsite and offsite digital delivery strategies for the technology.  
158 However, the top management faces several challenges in implementing the  
159 technologies and trying to get everyone to adapt to them. Most of the problems or  
160 barriers to technological changes were attributed to human resources, particularly  
161 changing the mindset of individuals who have routine ways of delivering projects.

162 TM2: *'These workers are more traditional therefore they are happy with previous*  
163 *technologies, and now they are asked to use digital. For some people, the change*  
164 *becomes a change too far. They are not ready to adapt to it because they don't quite*  
165 *understand the benefits.'*

166 TM3: *'Technology provides a lot of benefits, but the 'culture' that goes around, that*  
167 *is where you start getting the challenges. You can track people, but people do not want*  
168 *to be tracked or monitored, so how do you create an environment where the tracking is*  
169 *possible? Where we do not track the individual but track his/her trade. You cannot*  
170 *force technology on people. You cannot force people to change.'*

171 TM1: *'The client has a decision to make on whether to continue with the human,*  
172 *which is far cheaper, or invest in technology. The role of clients in promoting*  
173 *innovation and change is the difficult one.'*

174 The top management mentioned that the first step one takes, which is significant is  
175 getting people to see the value in changing their behaviours to take up new technologies.  
176 If operatives get to know the value, they will adapt more easily. TM1 indicated that the  
177 incentive operatives get by adapting to a technological change is the offer of training  
178 programmes, after which an Information Engineer is appointed to police the use of  
179 implemented technology because if this is not conducted appropriately, everyone will  
180 learn it improperly. Through innovation seminars, workshop meetings, and  
181 development programmes, the organisation enhances the awareness of technological  
182 processes and gives operatives the confidence, knowledge and skills needed. Scenarios  
183 and simulations are built to put processes and products into the context, which helps

184 with training programmes. TM2's organisation has set up a structure whereby each  
 185 division builds up a divisional innovation lead, and they have their innovation network  
 186 champions or scouts, encourage active and enthusiastic workers.

187 Operatives are not involved in the decision to implement technological changes if  
 188 the change is an industry standard, but TM2 admitted that middle-aged operatives with  
 189 new thinking suggest most changes in the organisation. These individuals are involved  
 190 in the implementation and testing of those technologies. The outcome of individual  
 191 adaptation to new technological changes is seen in the impact on the project delivery.

192 TM3: *'Through digital platforms, we can see the impact on the delivery of the*  
 193 *project. We benchmark where we are now in the project, institute the change through*  
 194 *software or approach and see individual behaviours through the digital platforms.'*

## 195 **5.2 Operatives Level (Individuals)**

196 According to the I-ADAPT theory, if the environment requires adaptation, any  
 197 dimensions of performance are determined by individual differences in adaptability.  
 198 The interviewees described technological changes and how they adapt to them.  
 199 Researchers were able to extract the antecedents of their adaptive behaviours. An  
 200 individual's adaptive behaviour could be predicted with the right leadership support.

201 OP5: *'Our HR talk about Yammer and encourage it, so that was one method to kind*  
 202 *of show what the executive directors expected of us. I had not heard about it, but when*  
 203 *I saw that the executive directors talk about it now, I wanted to know.'*

204 OP7: *'Innovation is so well supported and driven by the CEO. He does not only talk*  
 205 *about it but commits numbers and budget towards it.'*

206 A transformational leader is the source of inspiration and motivation for the  
 207 followers in inducing a desirable change [9]; indeed, as a result, an environment of  
 208 creativity, trust and accomplishment is developed [10]. Other interviewees referenced  
 209 either their personality as being open-minded or previous experiences with similar  
 210 technologies as determinants of their adaptive behaviours. Open-minded individuals  
 211 enjoy searching for and trying new things because they are imaginative and curious.

212 OP4: *'I was brought in because I already had a lot of experience with using it, so I*  
 213 *was tasked with leading it. It saves me time and information is more precise and more*  
 214 *traceable.'*

215 OP5: *'As part of my morning routine, I spend time on websites not looking for*  
 216 *anything but just trying to stay on top of new things as they come out because things*  
 217 *are moving quickly.'*

218 OP7: *'I am a very straightforward, direct kind of person, so I am not very interested*  
 219 *in these technological changes unless you convince me of the benefit or the value return*  
 220 *for myself.'*

221 The next step is to capture the operatives' understanding of adaptability and their  
 222 behaviours when there is a change in technology (see Table 1).

223 OP6: *'It was introduced to me by one of my senior colleagues in my first project. I*  
 224 *learnt it, and since then I have gotten used to it.'*

225 OP5: *'I understand the meaning of adaptability, and I consider it more as learning,*  
 226 *specifically on-the-job learning. My company coordinates with a technology company*

227 *to give some workshops to help us learn about the technology. These companies invent*  
228 *apps that assist us in our processes.'*

229 OP6: *'My company wanted everybody to know how to use it, and so they organised*  
230 *training for the workers. I attended a workshop and became familiar with the software.*  
231 *I also go to my friends to help me.'*

232 OP4: *'When there is a change, I learn how to change myself first. I change my habit.*  
233 *This is a good change, so it just takes some time, and gradually all the staff will follow*  
234 *the system.'*

235 From the exploratory study conducted, individual adaptability is operationalised as  
236 work behaviours relating to *'Learning new work tasks, technologies, and procedures'*,  
237 which is identified by Pulakos [11] as one of the sub-dimensions of adaptability.  
238 Adaptability can be learned and changed; hence, it is more malleable than individual  
239 traits [12]. A high-learning orientation contributes to individual adaptive behaviours  
240 which are established mostly through training programmes organised by their firms.

## 241 **6 Conclusions**

242 This study utilised an exploratory approach to understand the challenges regarding  
243 technological changes in construction organisations and the associated adaptive  
244 behaviours. It reveals that top management does not involve operatives in decision-  
245 making processes towards changing technological processes, which could be a  
246 contributing factor to the resistance shown by workers towards change. The study  
247 identified leadership skills, experience, and open-mindedness as significant predictors  
248 of adaptive behaviours in the context of technological change. In the said context,  
249 operatives adapt by learning new tasks, technologies and procedures. Such learning  
250 experiences mostly occur during effective training programmes. The results show that  
251 individuals are willing to accept and adapt to changes in technology if they understand  
252 the benefit or value it will bring to them. This confirms one of Homan's five basic  
253 propositions about human behaviour, which states that individuals are more likely to  
254 perform actions if there are valuable rewards. Technological changes or advancements  
255 vary from one organisation to another; hence, it is suggested that information about  
256 technologies which are successfully used on projects should be shared across the  
257 industry so that people become exposed to the change. By considering adaptability as  
258 a performance construct, [11] focused on learning new tasks, as well as the technology  
259 and the procedural dimension of adaptability, which was equated to trainability.  
260 Trainability is an inherent part of successful adaptation in response to technological  
261 change to acquire and apply expertise to solve problems creatively. While the  
262 exploratory approach is used to explore the research question, more data is required to  
263 confirm the findings and make them more generalisable. This study is followed by an  
264 intensive case study which will allow us to explore trainability and adaptability with  
265 greater precision.

## 266 Acknowledgements

267 The authors would like to thank the Research Grant Council “Willingness to share  
 268 construction safety knowledge via Web 2.0, mobile apps and IoT”,  
 269 UGC/FDS15/E01/17 and The University of Hong Kong for their support. We would  
 270 also like to express our special thanks of gratitude to all the interview participants for  
 271 their contribution to the study.

## 272 References

- 273 1. Parent, J.D.: Individual adaptation to the changing workplace: a model of causes,  
 274 consequences, and outcomes. In: Houdmont, J., Leka, S. (eds.) CONTEMPORARY  
 275 OCCUPATIONAL HEALTH PSYCHOLOGY: GLOBAL PERSPECTIVES ON  
 276 RESEARCH AND PRACTICE, pp. 188–207. Wiley-Blackwell, Chichester (2010)
- 277 2. Chan, D.: Understanding adaptation to changes in the work environment: Integrating  
 278 individual difference and learning perspectives. *Research in Personnel and Human  
 279 Resources Management* 18, 1-42 (2000).
- 280 3. Chan, D.: Interactive effects of situational judgment effectiveness and proactive personality  
 281 on work perception and work outcomes. *Journal of Applied Psychology* 91, 475-481 (2006).
- 282 4. Zelbst, P., Green, K., Sower, V., Reyes, P.: Impact of RFID on manufacturing effectiveness  
 283 and efficiency. *International Journal of Operations & Production Management* 32(3), 329–  
 284 350 (2012).
- 285 5. Lager, T., Frishammar, J.: Equipment supplier/user collaboration in the process industries:  
 286 In search of enhanced operating performance. *Journal of Manufacturing Technology  
 287 Management* 21(6), 698–720 (2010).
- 288 6. Stock, G., Tatikonda, M.: External technology integration in product and process  
 289 development. *International Journal of Operations & Production Management* 24(7), 642–  
 290 665 (2004).
- 291 7. Cooper, D.R., Schindler, P.S.: *Business Research Methods*. 9th edn. McGraw-Hill, USA  
 292 (2006).
- 293 8. Nargundkar, R.: *Marketing research-Text and Cases*, Tata. 2nd edn. McGrawHill Education  
 294 (2003).
- 295 9. Robbins, S.P., Coulter, M.: *Managing change and innovation*. In Robbins, S.P., Coulter, M.  
 296 (eds.) *MANAGEMENT*, pp. 384-415 (2007).
- 297 10. Mumford, M.D., Scott, G.M., Gaddis, B., Strange, J.M.: Leading creative people:  
 298 Orchestrating expertise and relationships. *The leadership quarterly* 13(6), 705–750 (2002).
- 299 11. Pulakos, E.D., Mueller-Hansen, R.A., Nelson, J.K.: Adaptive performance and trainability  
 300 as criteria in selection research. In Schmitt, N. (ed.) *OXFORD HANDBOOK OF  
 301 ASSESSMENT AND PERSONNEL SELECTION*, pp. 595-613. Oxford University Press,  
 302 New York (2012).
- 303 12. Ployhart, R.E., Bliese, P.D.: Individual adaptability (I-ADAPT) theory: Conceptualizing the  
 304 antecedents, consequences, and measurement of individual differences in adaptability. In  
 305 Burke, C.S., Pierce, L.G., Salas, E. (eds.) *ADVANCES IN HUMAN PERFORMANCE  
 306 AND COGNITIVE ENGINEERING RESEARCH*, pp. 3-40. Elsevier, New York (2006).