

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

3 Derek Asante Abankwa¹, Rita Yi Man Li², Steve Rowlinson¹ and Yadi Li¹

4 ¹ Department of Real Estate and Construction, The University of Hong Kong, Hong Kong

5 ² 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.

Participant / Years of experience	Role and Academic background	Technological changes
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).