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Challenges to Agile Project Management during COVID-19 Pandemic: An Emerging Economy Perspective

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Abstract

Globally, COVID-19 pandemic has affected more than 214 countries across the world, creating uncertainty and affecting every institution and individual. The organisations recognise the need of agile projects that may offer several benefits including faster deployments, adaptability and best fit alignment to fulfill the customer needs. Implementing agile projects is the key to survive in the post pandemic situation, but emerging economies have limited scope for implementation. The present study determines the critical factors that restricts implementation of agile projects in emerging economies. The critical factors are identified from literature and validated by experts. The validated critical factors are further assessed to identify the cause-and-effect relationship using Fuzzy Decision-Making Trial and Laboratory (F-DEMATEL) method. The results of the study posit 'Skepticism towards the new way of working' is the most significant causal factor affecting other factors. This study is an attempt to help project managers to consider the significant factors for agile project implementation in post pandemic situation. The project managers may be benefitted from this study by considering these factors to manage challenges for agile project

31 implementation in emerging economies. This study contributes to assess the influencing and the
32 influenced challenging factors for agile project implementation.

33

34 **Keywords**

35 Project management; Agile transformation; COVID-19; Emerging economies; Industry 4.0
36 technologies

37

38 **1. Introduction**

39

40 COVID-19 has caused a substantial disruption in the firms functioning and their transactions with
41 government, health, monetary and other businesses (Ivanov, 2021). Researchers in the area of agile
42 transformation know the significance and the need of it for the firms during this pandemic. The
43 scope of agile projects become prominent due to inevitable disruption caused by the COVID-19
44 (Batra, 2020). Agile project management has gained popularity for last two decades as a substitute
45 of traditional methods such as waterfall that covered only the core value and ability to respond
46 promptly to the dynamic business requirements, processes, technologies and conditions
47 (Fernandez and Fernandez, 2008; Ciric et al., 2019). These projects emphasise on the
48 collaborative, people-oriented approach towards software development (Cooper and Sommer,
49 2018). The manager's role in the scrum master on agile projects is to facilitate adaptive leadership,
50 processes, remove obstacles, and develop motivation for their teams. This has the changed the role
51 of command-and-control style of the manager in the agile settings (Nerur et al., 2005). However,
52 agile project teams advocate self-organising teams displaying high levels of autonomy, but Several
53 challenges emerge when these self-organising teams closely work with routinized activities of
54 projects such as estimation, planning and elicitation (Venkatesh et al., 2020). Several benefits are
55 offered by the agile projects including faster deployments, adaptability and best fit alignment with
56 the firm's and customer needs, but still the adoption and implementation of these projects is
57 challenging (Hoda and Murugesan, 2016; Sjödin et al., 2020).

58

59 The situation during COVID-19 has generated extreme uncertainty across the globe affecting
60 every institution and individual (Dohaney et al., 2020; Ivanov, 2021). Now, the firms look for
61 technologies and systems that may strengthen their capabilities to tackle the uncertainty. The

62 inclusion of artificial intelligence, data analytics and other industry 4.0 technologies has
63 transformed the existing systems and opens the door for agility (Holden et al., 2021). During
64 disruption, the resources need to be optimised for developing capabilities and building agility
65 (Blome et al., 2013; Nandi et al., 2021). But what are the challenges faced by the firms to adopt
66 and manage agile projects in emerging economies where the resources are scarce and industry 4.0
67 implementation is in nascent phase? The present research aims to evaluate the challenges using F-
68 DEMATEL analysis that restrict implementation of agile project during COVID-19. This study
69 tries to demonstrates relationship among challenging factors that offers opportunities to decide
70 how these agile projects could benefit firms to address pandemic situation in future. Hence, this
71 study establishes objectives to delineate set of challenging factors that can help the project
72 managers and can contribute to existing theory for understanding the challenges to agile project
73 implementation. Based on this discussion, the present study focuses on the following research
74 objectives:

75 *ROI*: Identifying challenging factors to agile project implementation during COVID-19 in
76 emerging economies like India?

77 *RO2*: Modeling factors for investigating interrelationship and building hierarchy for the same.

78 *RO3*: Suggesting measures for agile transformation in projects to address the disruption in future.

79

80 The outcomes of the study will facilitate the project managers and decision makers to implement
81 agile projects for handling disruptive environment. The research study presents a distinct
82 contribution in the direction of project management in context to COVID-19. A literature review
83 is conducted to identify the challenging factors to agile project implementation during pandemic
84 situation. The methodological procedure employed three phases- systematic literature review was
85 conducted in phase I followed by the assessment of factors using F-DEMATEL in phase II. In
86 phase III the discussion and implications are discussed for project managers.

87

88 The organisation of this research paper is as: Section 2 captures the various challenging factors
89 based on literature review and experts' validation. Section 3 describes the research methodology
90 undertaken in the study. Section 4 elaborates application of methods cause and effect
91 interrelationship computations. Section 5 presents the discussion of findings of the study. Section
92 6 concludes with limitations and future research directions.

93

94 2. Literature Review

95

96 Through literature review the published literature on project management implementation, agile
97 transformation and challenges was searched using “Scopus” and “Web of Science (WoS)”
98 databases. The search terms such as “project management implementation”, “agile
99 transformation” “Implementation of agile project implementation”, “Agile projects during
100 COVID-19” were used to search the pertinent articles. The research is limited to for last five years.
101 A total of 45 articles were found relevant for the study.

102

103 2.1 Agile Project Management Implementation

104 With Industry 4.0 revolution, the emerging economies are transforming their manufacturing sector
105 (Ding et al., 2021; Sharma et al., 2021). The most important challenge in manufacturing industry
106 is to develop the resilience across the value chain. Automation provides a time-saving and efficient
107 approach towards executing manual tasks, but India has slow rate of automation (Sharma et al.,
108 2021). Agility not only limited to competitiveness but also brings innovation and improves
109 adoption for the change to the system and consequently. Previous research described agility led to
110 reduce cost and improve efficiency (Orłowski et al., 2017). Few research studies also showed that
111 agile projects are implemented across industries where methods such as Scrum and Kanban do not
112 focus on comprehensive advanced planning and execution, rather develop a solution step by step
113 and coordinates respective interim results in short cycles (Conforto et al., 2014; Lei et al., 2017;
114 Saragih et al., 2021). Flexibility is facilitated with agile projects, and thereby enabling companies
115 to take actions with dynamic customer needs (Koch and Schermuly, 2021). The research gap may
116 be summarised as there is no study that has analysed the challenging factors to agile project
117 implementation in emerging economies. Accordingly, the research questions are addressed.

118

119 The successful execution of the projects depends on different project types, and models. A
120 procedural model organises the methods into phases in standardised way. Procedural models are
121 categorised into two methods: 1) plan-driven methods that follows classical waterfall model 2)
122 agile methods following test driven approach (Lei et al., 2017). Hybrid approaches combine the
123 advantage of both the models to enrich the plan-driven process model with agile principles

124 (Patanakul and Rufo-McCarron, 2018). The selection of a model is quite challenging. Based on
 125 the literature, following are the challenging factors to agile project implementation are listed below
 126 in the Table 1.

127

128 **Table 1:** Challenging factors to agile project implementation during COVID-19 in emerging
 129 Economies

Code	Variables	Implied Meaning	References
F1	Investment decisions require up-front certainty	Organisations must realise the changing need where stakeholders should be encouraged to take upfront certainty and stop watching investments as iterative test-and-learn cycle.	Djödin et al., 2020; Tsoy and Staples, 2020.
F2	Third party involvement	The challenge is to manage with the partners or third parties those are not able to adapt agile transformations.	Holden and Azar, 2021; Shastri, et al., 2021
F3	Loss of control	Due to agile projects, the control is distributed among the team which may annoy the stakeholders to reassert controls and governance that no longer apply.	Lill and Wald, 2021
F4	Automation landscape insufficiently mature	Agile project implementation creates challenges that can be solved with the automation. But, due to lack of automation adopted by the organisation creates struggle to cope with the agile transformation.	Baham and Hirschheim, 2021; Scholz et al., 2021
F5	Less motivation and enthusiasm due to COVID-19 impact	COVID-19 negatively affects budget, hence affects value generation adversely creating less motivation and enthusiasm.	Koch and Schermuly, 2021; Malik, et al. 2021
F6	Projects take too long to get going	Agile project implementation is hampered by indecision and also inability of organisation to take prompt decision.	Ragas and Ragas, 2021

F7	Slow Governance processes	Agile project implementation will lead into conflicts with existing systems and processes leading into slow governance.	Sjödin et al.2020; Ragas and Ragas, 2021
F8	Non- availability of skilled people	The emerging economies like India are lacking in skilled staff. Thus, agile project implementation is difficult if the manpower is non-skilled.	Koch and Schermuly, 2021; Niederman, 2021
F9	Risk mitigation	Agile is more active in risk management as compared to waterfall model.	Sithambaram et al. 2021
F10	Structural impediments	A set of exiting conditions may thwart the agile project management implementation.	Narkhede et al. 2020
F11	Lack of clarity around roles	Agile project focuses on team roles that may create ambiguity in the job roles.	Malik et al. 2021
F12	Resistance to Change	Challenges are faced when exposed to the other parts of the organisation for adopting the agile projects.	Sithambaram et al. 2021
F13	Lack of shared value	Challenge to agile projects implementation is the shared value that occurs due to multiple teams.	Hoda and Murugesan, 2016; Baham and Hirschheim, 2021
F14	Skepticism towards the new way of working	Skepticism is the common problem in the agile project implementation. At one hand there are benefits of agility, but on the other hand opposition to implement it.	Zasa et al. 2021; Baham and Hirschheim, 2021
F15	Lack of investment	The lack of funding may hamper to implement agile projects.	Holden and Azar, 2021
F16	Misunderstanding agile concepts	Agile Projects needs to be implemented with concepts and planning but due to lack of clarity it sometimes misleads the project managers.	Sithambaram et al. 2021
F17	Lack of coordination in multi-team environment	There are challenges of coordination among the team members which restricts to implement agile projects.	Hoda and Murugesan, 2016.

F 18	Requirement's ambiguity affects quality	In context to requirements engineering, agile projects may need to extend to accommodate additional testing activities. The inability to extend the testing may create problems for agile project implementation.	Rindell et al. 2021
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130

131 3. Proposed research framework

132 The current study has conducted a three-phase study shown in Figure 1 demonstrating the proposed
133 framework adopted for conducting the study.

134

135 Fig. 1 Proposed research framework

136

137 During first phase, the challenges to agile project implementation during COVID-19 were
138 identified through literature review. F-DEMATEL method was applied to examine the cause-and-
139 effect among the challenging factors identified in the second phase. F-DEMATEL is one of the
140 widely used methods in several disciplines (Kumar et al., 2018; Luthra et al., 2020). In the third
141 phase a discussion and implication are discussed for effective project implementation for the future
142 research work. This research focuses on presenting information by the means of experiences of the
143 experts who were contacted to participate in the study. This study attempted to analyse and
144 investigate the challenges that are crucial for organisations for implementing agile project
145 implementation. The factors that were analysed and investigated were largely challenging to get a
146 deeper understanding of the problem statement. Initially, the challenges were identified from
147 literature and validated from the experts. The establishment of the relations between the cause and
148 effect of the identified factors was also evident while investigating and validating these factors.
149 The following sub-sections explain all the adopted steps in the research methodology undertaken.

150

151 3.1 Data Collection

152 A questionnaire was used to receive the response of the experts. The experts validated the
153 identified challenging factors from the literature. A total of 15 experts were undertaken from the
154 manufacturing industries including automotive, electronics, software etc. All the experts

155 undertaken had prior knowledge about agile project implementation. The experience of the experts
 156 was 5+ years and were designated at the managerial positions.

157

158 3.2 Determining Causal Relationships between Challenging Factors

159 F-DEMATEL method is used in the current study to determine the interrelationship among the
 160 challenging factors. It is the most suitable method to observe the inter-relationship among the
 161 factors (Si et al., 2018). Also, F-DEMATEL can address the biases and vagueness in human
 162 judgments (Farooque et al., 2020). All the variables were assessed based on linguistic scale
 163 mentioned in Table 2.

164

165 *Step 1: Developing a fuzzy direct relation matrix*

166 The experts were asked to evaluate the impact of factor i on factor j using a linguistic scale shown
 167 in Table 2. Triangular fuzzy numbers (TFNs) were used for capturing the fuzziness in the
 168 judgments (Seçme et al., 2009). Table 2 exhibits the fuzzy linguistic scale (Venkatesh et al., 2017;
 169 Wu & Lee, 2007) to convert impact scores to triangular fuzzy numbers.

170

171 **Table 2** Linguistic labels

Linguistic terms	Triangular fuzzy numbers
Very High (VH)	(0.9, 1.0, 1.0)
High (H)	(0.7, .9, 1.0)
Medium High (MH)	(0.5, 0.7, .9)
Medium (M)	(0.3, 0.5, 0.7)
Medium low (ML)	(0.1, 0.3, 0.5)
Low (L)	(0, 0.1, 0.3)
Very Low (VL)	(0, 0, 0.1)

172

173 The fuzzy direct relation matrix $Z = [Z_{ij}]_{n \times n}$ is obtained through Eq.1-3

$$174 \quad x_{ij}^k = (l_{ij}^k - \min l_{ij}^k) / \Delta_{\min}^{\max} \quad (1)$$

$$175 \quad x_{mj}^k = (m_{ij}^k - \min l_{ij}^k) / \Delta_{\min}^{\max} \quad (2)$$

$$176 \quad x_{rj}^k = (r_{ij}^k - \min l_{ij}^k) / \Delta_{\min}^{\max} \quad (3)$$

177

178 where $\Delta_{\min}^{\max} = \max r_{ij}^k - \min l_{ij}^k$

179

180 **Step 2: Constructing the normalised direct relation matrix using Eq.4**

$$181 \quad m = \min \left[\frac{1}{\max \sum_{j=1}^n |a_{ij}|}, \frac{1}{\max \sum_{i=1}^n |a_{ij}|} \right] \quad (4)$$

182 Integrating crisp value through

$$183 \quad Z_{ij} = \frac{1}{p} (Z_{ij}^1 + Z_{ij}^2 + Z_{ij}^p) \quad (5)$$

184 **Step 3: Developing total relation matrix using Eq.6**

$$185 \quad T = N(I - N)^{-1} \quad (6)$$

186

187 **Step 4: Calculating the sum of rows (D) and the sum of columns (R) using equation (7) and**

188 **(8)**

189

$$190 \quad D = [\sum_{j=1}^n t_{ij}]_{n \times 1} \quad (7)$$

191

$$192 \quad R = [\sum_{i=1}^n t_{ij}]_{1 \times n} \quad (8)$$

193 **Step 5: Creating the cause-effect diagram**

194 Based on the values of D+R and D-R, a cause-effect diagram (Figure 2) is drawn using. (D+R)
 195 presents horizontal axis that determines the prominence of a factor, signifying its total effects in
 196 terms of influenced and influential power. (D-R) presents vertical axis that describes the causal-
 197 effect relationship between the challenging factors. A factor is categorised in cause group when
 198 (D-R) value is more than zero. On the contrary, a factor is categorised in effect group when (D-R)
 199 value is less than zero. The normalised direct relation matrix and total relation matrix using Eq. 4,
 200 5, and 6 are shown in Table 3 and 4.

201

202

203

204

205 Table 3 Normalised Tables for all three fuzzy values l, m, u

Total Normalised Direct-Relation Matrix for l, m, u																		
(l)																		
F1	0	.02 29	.019 0	.03 36	.030 1	.04 77	.03 49	.03 49	.02 00	.018 9	.01 26	.02 22	.003 71	.033 9	.002 33	.002 43	.001 48	.016 9
F2	.03 32	0	.033 5	.04 62	.031 5	.00 10	.04 03	.04 2	.04 03	.001 0	.03 61	.03 07	.029 6	.030 7	.022 3	.012 7	.044 5	.033 8
F3	.03 19	.03 05	0	.01 58	.011 6	.01 69	.00 63	.01 9	.01 48	.016 9	.01 58	.01 89	.024 3	.013 7	.014 7	.021 1	.016 9	.031 7
F4	.02 13	.02 11	0.02 54	0	.048 5	.01 69	.04 03	.02 32	.03 71	.020 1	.01 80	.03 08	.027 5	.034 9	.032 8	.021 1	.032 9	.036 1
F5	.02 39	.00 80	.035 6	.00 50	0	.00 10	.02 75	.03 28	.00 62	.015 8	.02 11	.03 39	.024 3	.041 3	.016 9	.014 8	.032 8	.030 7
F6	.03 93	.02 00	.004 1	.00 10	.016 9	0	.01 69	.02 65	.01 68	.022 2	.03 71	.02 96	.023 2	.036 0	.030 7	.010 6	.007 4	.016 9
F7	.01 04	.02 00	.021 1	.02 76	.032 8	.01 69	0	.03 82	.03 28	.022 2	.02 11	.01 69	.034 9	.029 6	.028 5	.028 5	.033 8	.016 9
F8	.02 00	.02 42	.023 1	.04 34	.048 7	.04 87	.01 69	0	.04 87	.016 8	.03 81	.02 64	.037 0	.026 5	.029 6	.029 5	.033 9	.048 7
F9	.01 80	.02 43	.030 6	.02 53	.019 0	.02 73	.02 43	.01 90	0	.016 9	.03 07	.02 12	.027 5	.024 3	.024 2	.026 4	.025 3	.044 4
F1	.02 0	.02 76	.019 54	.02 21	.019 9	.01 78	.03 71	.02 65	.00 10	0	.01 69	.03 08	.031 8	.018 0	.019 0	.005 1	.043 4	.025 3
F1	.03 1	.02 72	.034 33	.02 31	.024 2	.02 74	.02 11	.03 49	.02 65	.016 9	0	.01 69	.004 1	.005 2	.007 3	.040 2	.032 8	.004 2
F1	.01 2	.02 16	.034 65	.02 24	.016 9	.03 61	.04 02	.01 90	.01 79	.017 9	.01 69	0	.016 9	.004 2	.007 3	.011 6	.004 1	.042 3
F1	.03 3	.01 50	.019 90	.02 54	.021 0	.01 89	.03 07	.03 40	.02 10	.046 6	.02 23	.01 69	0	.032 8	.032 8	.042 3	.019 0	.042 3
F1	.02 4	.02 75	.03 06	.028 4	.027 95	.02 3	.01 21	.03 14	.04 07	.042 3	.03 18	.01 79	.048 7	0	.032 8	.042 3	.038 8	.038 0
F1	.02 5	.02 01	.025 43	.03 48	.023 3	.03 80	.03 91	.01 48	.04 87	.016 8	.03 28	.01 69	.001 0	.001 0	0	.001 0	.016 9	.038 1
F1	.03 6	.02 18	.022 54	.02 32	.034 8	.03 16	.03 39	.02 97	.04 87	.045 6	.02 23	.01 69	.016 9	.001 0	.001 0	0	.016 9	.032 8
F1	.02 7	.02 11	.025 33	.02 32	.039 1	.02 54	.03 07	.03 28	.03 28	.016 9	.01 69	.01 69	.016 9	.016 9	.016 9	.016 9	0	.017 9
F1	.00 8	.02 21	.028 01	.02 55	.043 5	.02 96	.02 55	.00 73	.02 65	.022 2	.00 72	.00 40	.033 9	.032 9	.006 2	.032 9	.006 2	0
(m)																		
F1	0	.03 72	.033 7	.04 83	.044 8	.06 26	.04 98	.04 98	.03 49	.033 8	.02 54	.03 71	.052 0	.048 8	.038 2	.039 2	.029 7	.031 8
F2	.04 58	0	.047 8	.06 04	.041 5	.01 59	.05 52	.05 73	.05 52	.015 9	.05 10	.04 56	.044 5	.045 6	.037 2	.027 6	.059 4	.048 7
F3	.04 66	.04 52	0	.03 01	.026 2	.03 18	.02 12	.03 39	.02 97	.031 8	.03 07	.02 85	.003 92	.028 6	.029 6	.036 0	.031 8	.046 6
F4	.03 60	.03 58	.039 7	0	.063 2	.03 18	.05 52	.03 81	.05 21	.035 0	.03 29	.04 57	.042 4	.004 98	.047 7	.036 0	.047 8	.051 0
F5	.03 82	.02 23	.049 8	.01 97	0	.01 59	.04 24	.04 77	.02 11	.028 6	.03 60	.04 88	.039 2	.056 2	.031 8	.029 7	.047 7	.045 6
F6	.05 42	.03 49	.019 0	.00 21	.031 8	0	.03 18	.04 14	.02 32	.003 71	.05 20	.04 45	.038 1	.050 9	.045 7	.025 5	.022 3	.031 8
F7	.02 53	.03 49	.036 0	.04 25	.047 7	.03 18	0	.05 31	.04 77	.037 1	.03 60	.03 18	.049 8	.043 4	.043 4	.043 4	.048 7	.031 8
F8	.03 49	.03 91	.038 0	.05 83	.063 6	.06 36	.03 18	0	.06 36	.031 7	.05 30	.04 13	.051 9	.041 4	.044 5	.044 4	.048 8	.063 6
F9	.03 29	.03 92	.045 5	.04 02	.033 9	.04 22	.03 92	.03 39	0	.003 18	.04 56	.03 61	.042 4	.039 2	.039 1	.041 3	.040 2	.059 3
F1	.04 0	.04 15	.033 9	.03 70	.029 5	.03 27	.05 20	.04 14	.01 59	0	.03 18	.04 57	.046 7	.032 9	.033 9	.010 4	.058 3	.040 2
F1	.05 21	.03 82	.049 8	.03 80	.039 1	.04 23	.03 60	.04 98	.04 14	.031 8	0	.03 18	.019 0	.020 1	.020 0	.055 1	.047 7	.018 0
F1	.02 2	.04 65	.048 9	.03 41	.031 8	.05 10	.05 51	.03 39	.03 28	.032 8	.03 18	0	.031 8	.019 1	.022 2	.026 5	.019 0	.057 2

F1 3	.04 99	.03 39	.032 8	.04 03	0.03 59	.03 38	.04 56	.04 89	.03 59	.061 5	.03 72	.03 18	0	.047 7	.047 7	.057 2	.033 9	.057 2
F1 4	.04 24	.04 44	.041 2	.04 44	.042 2	.03 70	.02 41	.04 56	.05 93	.057 2	.04 67	.03 28	.063 6	0	.047 7	.057 2	.047 7	0.05 08
F1 5	.03 50	.03 92	.040 2	.04 97	.037 1	.05 29	.05 40	.02 97	.06 36	.022 2	.04 77	.03 18	.015 9	.015 9	0	.015 9	.031 8	.053 0
F1 6	.04 67	.04 03	.037 1	.03 81	.049 7	.04 65	.04 88	.04 46	.06 36	.060 5	.03 72	.03 18	.031 8	.015 9	.015 9	0	.031 8	.047 7
F1 7	.03 60	.03 82	.040 2	.03 81	.054 0	.04 03	.04 56	.04 77	.04 77	.031 8	.03 18	.03 18	.031 8	.031 8	.031 8	.031 8	0	.032 8
F1 8	.01 48	.03 49	.043 5	.04 14	.058 3	.04 45	.04 03	.02 54	.04 14	.037 0	.02 21	.01 89	.048 8	.047 7	.019 0	.047 7	.021 1	0
(u)																		
F1 0		.03 72	.033 7	.04 83	.044 8	.06 26	.04 98	.04 98	.03 49	.033 8	.02 54	.03 71	.052 0	.048 8	.038 2	.039 2	.029 7	.031 8
F2 58	.04 58	0	.047 8	.06 04	.041 5	.01 59	.05 52	.05 73	.05 52	.015 9	.05 10	.04 56	.044 5	.045 6	.037 2	.027 6	.059 4	.048 7
F3 66	.04 66	.04 52	0	.03 01	.026 2	.03 18	.02 12	.03 39	.02 97	.031 8	.03 07	.02 85	.039 2	.028 6	.029 6	.036 0	.031 8	.046 6
F4 60	.03 60	.03 58	.039 7	0	.063 2	.03 18	.05 52	.03 81	.05 21	.035 0	.03 29	.04 57	.042 4	.049 8	.047 7	.036 0	.047 8	.051 0
F5 82	.03 82	.02 23	.049 8	.01 97	0	.01 59	.04 24	.04 77	.02 11	.028 6	.03 60	.04 88	.039 2	.056 2	.031 8	.029 7	.047 7	.045 6
F6 42	.05 42	.03 49	.019 0	.00 21	.031 8	0	.03 18	.04 14	.02 32	.037 1	.05 20	.04 45	.038 1	.050 9	.045 7	.025 5	.022 3	.031 8
F7 53	.02 53	.03 49	.036 0	.04 25	.047 7	.03 18	0	.05 31	.04 77	.037 1	.03 60	.03 18	.049 8	.043 4	.043 4	.043 4	.048 7	.031 8
F8 49	.03 49	.03 91	.038 0	.05 83	.063 6	.06 36	.03 18	0	.06 36	.031 7	.05 30	.04 13	.051 9	.041 4	.044 5	.044 4	.048 8	.063 6
F9 9	.032 9	.03 92	.045 5	.04 02	.033 9	.04 22	.03 92	.03 39	0	.031 8	.04 56	.03 61	.042 4	.039 2	.039 1	.041 3	.040 2	.059 3
F1 0	.04 15	.04 03	.033 9	.03 70	.029 5	.03 27	.05 20	.04 14	.01 59	0	.03 18	.04 57	.046 7	.032 9	.033 9	.010 4	.058 3	.040 2
F1 1	.05 21	.03 82	.049 8	.03 80	.039 1	.04 23	.03 60	.04 98	.04 14	.031 8	0	.03 18	.019 0	.020 1	.020 1	.055 1	.047 7	.018 0
F1 2	.02 65	.04 04	.048 9	.03 41	.031 8	.05 10	.05 51	.03 39	.03 28	.032 8	.03 18	0	.031 8	.019 1	.022 2	.026 5	.019 0	.057 2
F1 3	.04 99	.03 39	.032 8	.04 03	.035 9	.03 38	.04 56	.04 89	.03 59	.061 5	.03 72	.03 18	0	.047 7	.047 7	.057 2	.033 9	.057 2
F1 4	.04 24	.04 44	.041 2	.04 44	.042 2	.03 70	.02 41	.04 56	.05 93	.057 2	.04 67	.03 28	.063 6	0	.047 7	.057 2	.047 7	.050 8
F1 5	.03 50	.03 92	.040 2	.04 97	.037 1	.05 29	.05 40	.02 97	.06 36	.022 2	.04 77	.03 18	.015 9	.015 9	0	.015 9	.031 8	.053 0
F1 6	.04 67	.04 03	.037 1	.03 81	.049 7	.04 65	.04 88	.04 46	.06 36	.060 5	.03 72	.03 18	.031 8	.015 9	.015 9	0	.031 8	.047 7
F1 7	.03 60	.03 82	.040 2	.03 81	.054 0	.04 03	.04 56	.04 77	.04 77	.031 8	.03 18	.03 18	.031 8	.031 8	.031 8	.031 8	0	.032 8
F1 8	.01 48	.03 49	.043 5	.04 14	.058 3	.04 45	.04 03	.02 54	.04 14	.037 0	.02 21	.01 89	.048 8	.047 7	.019 0	.047 7	.021 1	0

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212 Table 4 Total-Relation matrix T

Total-Relation matrix T of fuzzy number (l, m, u)																
<i>(l)</i>																
F1	.0186	.0396	.0373	.0514	.0513	.0648	.0547	.0549	.0414	.0361	.0310	.0386	.0562	.0513	.0394	.0412
F2	.0521	.0197	.0552	.0669	.0565	.0232	.0627	.0645	.0642	.0201	.0548	.0482	.0514	.0501	.0398	.0334
F3	.0442	.0422	.0138	.0297	.0275	.0305	.0219	.0335	.0301	.0287	.0281	.0303	.0381	.0264	.0255	.0332
F4	.0398	.0391	.0460	.0203	.0704	.0365	.0616	.0448	.0590	.0379	.0366	.0474	.0482	.0531	.0487	.0394
F5	.0379	.0228	.0507	.0214	.0183	.0176	.0435	.0489	.0244	.0300	.0348	.0458	.0405	.0540	.0293	.0298
F6	.0529	.0336	.0198	.0173	.0337	.0161	.0335	.0426	.0338	.0352	.0505	.0418	.0384	.0485	.0425	.0248
F7	.0282	.0363	.0394	.0454	.0534	.0348	.0203	.0571	.0532	.0384	.0382	.0326	.0528	.0456	.0432	.0448
F8	.0421	.0445	.0463	.0644	.0740	.0698	.0425	.0250	.0730	.0373	.0587	.0459	.0595	.0480	.0479	.0502
F9	.0349	.0402	.0480	.0426	.0395	.0444	.0434	.0380	.0205	.0328	.0464	.0358	.0453	.0402	.0381	.0425
F10	.0422	.0396	.0351	.0383	.0390	.0338	.0545	.0441	.0199	.0142	.0315	.0440	.0480	.0332	.0324	.0202
F11	.0519	.0375	.0498	.0386	.0424	.0431	.0383	.0518	.0441	.0303	.0151	.0310	.0210	.0201	.0203	.0531
F12	.0251	.0389	.0473	.0360	.0333	.0488	.0545	.0341	.0333	.0300	.0299	.0124	.0320	.0186	.0193	.0247
F13	.0531	.0372	.0388	.0455	.0445	.0393	.0525	.0548	.0438	.0636	.0404	.0339	.0215	.0503	.0483	.0594
F14	.0489	.0504	.0506	.0516	.0528	.0441	.0369	.0543	.0684	.0616	.0519	.0370	.0701	.0206	.0502	.0617
F15	.0348	.0384	.0413	.0497	.0416	.0527	.0558	.0320	.0649	.0296	.0471	.0309	.0182	.0173	.0135	.0160
F16	.0482	.0411	.0399	.0405	.0548	.0485	.0531	.0488	.0661	.0596	.0385	.0329	.0362	.0193	.0163	.0164
F17	.0364	.0376	.0414	.0390	.0570	.0409	.0478	.0500	.0503	.0308	.0323	.0313	.0340	.0325	.0305	.0316
F18	.0174	.0331	.0430	.0389	.0591	.0421	.0410	.0241	.0423	.0361	.0215	.0175	.0492	.0467	.0191	.0460
<i>(m)</i>																
F1	.0793	.1125	.1135	.1254	.1311	.1407	.1343	.1345	.1211	.1080	.1037	.1104	.1335	.1249	.1100	.1140
F2	.1283	.0831	.1346	.1447	.1362	.1044	.1463	.1481	.1481	.0964	.1328	.1235	.1329	.1276	.1141	.1105
F3	.1093	.1062	.0666	.0949	.0979	.0976	.0923	.1037	.1004	.0919	.0935	.0883	.1061	.0915	.0876	.0970
F4	.1171	.1152	.1244	.0839	.1527	.1160	.1440	.1277	.1415	.1123	.1139	.1217	.1286	.1294	.1216	0.1150
F5	.1066	.0906	.1205	.0912	.0786	.0891	.1174	.1226	.0990	.0948	.1038	.1120	.1124	.1220	.0948	.0975
F6	.1186	.0987	.0878	.0710	.1045	.0697	.1041	.1133	.0965	.0988	.1159	.1052	.1070	.1134	.1045	.0894
F7	.1025	.1092	.1150	.1194	.1325	.1107	.0854	.1358	.1320	.1094	.1119	.1039	.1294	.1176	.1129	.1166
F8	.1246	.1256	.1305	.1461	.1618	.1535	.1308	.0992	.1603	.1166	.1404	.1251	.1449	.1295	.1255	.1303
F9	.1084	.1124	.1228	.1160	.1185	.1194	.1219	.1167	.0849	.1035	.1193	.1064	.1215	.1128	.1074	.1140
F10	.1101	.1075	.1057	.1075	.1080	.1045	.1278	.1177	.0941	.0664	.1004	.1102	.1196	1016	.0979	.0790
F11	.1215	.1062	.1210	.1084	.1174	.1145	.1131	.1262	.1186	.0979	.0706	.0983	.0942	.0898	.0848	.1207
F12	.0925	.1038	.1156	.0999	.1054	.1170	.1257	.1060	.1050	.0947	.0968	.0627	.1019	.0854	.0829	.0904
F13	.1298	.1131	.1167	.1227	.1272	.1183	.1347	.1370	.1262	.1370	.1171	.1082	.0876	.1263	.1208	.1337
F14	.1292	.1284	.1306	.1319	.1388	.1266	.1212	.1403	.1538	.1383	.1318	.1146	.1531	.0862	.1260	.1394
F15	.1045	.1068	.1125	.1189	.1154	.1236	.1297	.1067	.1387	.0878	.1162	.0978	.0911	.0867	.0652	.0846
F16	.1218	.1137	.1154	.1144	.1336	.1238	.1318	.1277	.1443	.1301	.1120	.1040	.1131	.0929	.0866	.0740
F17	.1074	.1074	.1139	.1100	.1328	.1134	.1235	.1256	.1259	.0992	.1031	.0996	.1079	.1028	.0977	.1009

F18	.0844	.1004	.1126	.1083	.1320	.1119	.1140	.1006	.1153	1019	.0901	.0838	.1200	.1141	.0822	.1123	
(u)																	
F1	.3836	.4358	.4465	.4431	.4604	.4448	.4735	.4668	.4452	.4158	.4356	.4228	.4548	.4316	.4193	0.4216	
F2	.4341	.3882	.4514	.4440	.4500	.4174	.4715	.4663	.4605	04009	.4551	.4326	.4493	.4289	.4213	0.4146	
F3	.4069	.4090	.3627	.3923	.4044	.3952	.4116	0.4183	.4083	03797	.4005	.3810	.4131	.3861	.3777	0.3855	
F4	.4354	.4393	.4554	.3874	.4671	.4343	.4749	.4611	.4600	04195	.4460	.4321	.4586	.4351	.4264	0.4235	
F5	.4126	.4034	.4391	.3980	.3824	.3966	.4468	.4472	.4171	03928	.4229	.4093	.4291	.4181	.3956	0.3933	
F6	.4013	.3940	.3905	.3619	.4059	.3447	.4155	.4201	.3950	03806	.4141	0.3859	.4083	.3930	.3817	0.3699	
F7	.4249	.4374	.4510	.4421	.4667	.4339	.4176	.4675	.4654	04228	.4478	.4252	.4579	.4296	.4279	0.4306	
F8	.4558	.4609	.4741	.4650	.4892	.4701	.4861	.4351	.4877	04339	.4812	.4545	.4809	.4547	.4511	0.4506	
F9	.4327	.4406	.4566	.4356	.4514	.4381	.4687	.4579	.4047	04175	.4553	.4269	.4571	.4326	.4239	0.4292	
F10	.4124	.4192	.4250	.4081	.4216	.4064	.4470	.4395	.4108	03486	.4189	.4134	.4364	.4038	.3966	0.3778	
F11	.4199	.4166	.4355	.4106	.4293	.4143	.4392	.4465	.4337	03941	.3737	.4012	.4104	.3909	.3836	0.4076	
F12	.3809	.3922	.4096	.3825	.4030	.3986	.4248	.4099	.4034	03750	.3973	.3345	.4012	.3706	.3652	0.3700	
F13	.4442	.4408	.4512	.4419	.4566	.4346	.4760	.4687	.4563	04347	.4528	.4281	.4063	.4441	.4366	0.4356	
F14	.4518	.4577	.4705	.4526	.4717	.4484	.4697	.4788	.4801	04451	.4728	.4399	0.4773	.3950	.4471	0.4462	
F15	.4073	.4150	.4286	.4157	.4280	.4206	.4473	.4254	.4371	0.3781	.4312	.3985	.4060	.3862	.3473	0.3809	
F16	.4299	.4339	.4420	.4269	.4511	.4312	.4656	.4502	.4540	04208	.4386	.4152	.4385	.4031	.3947	0.3658	
F17	.4284	.4351	.4492	.4310	.4604	.4356	.4687	.4659	.4588	04121	.4387	.4193	.4424	.4213	.4136	0.4153	
F18	.3921	.4127	.4327	.4131	.4386	.4191	.4427	.4230	.4325	03991	.4080	.3875	.4371	.4168	0.3824	.4111	

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From step 4, using Eq. 7 and 8, (D + R) and (D-R) values are computed and shown in Table 5.

Table 5 Values for the causal diagram

	Di			Ri			Di+Ri			Di-Ri			Crisp Di+Ri	Crisp Di-Ri
	l	m	u	l	m	U	l	m	u	l	m	u		
F1	0.7811	2.1296	7.9062	0.7088	1.9961	7.5541	1.4899	4.1257	15.4603	-6.7730	0.1335	7.1974	5.9178	0.1340
F2	0.8864	2.3014	7.9212	0.6719	1.9408	7.6318	1.5583	4.2422	15.5530	-6.7454	0.3606	7.2493	6.0176	0.2723
F3	0.5606	1.7409	7.1769	0.7438	2.0599	7.8718	1.3044	3.8007	15.0487	-7.3112	-0.3190	6.4331	5.6146	-0.3097
F4	0.8407	2.2413	7.9854	0.7374	2.0143	7.5519	1.5782	4.2556	15.5373	-6.7112	0.2269	7.2479	6.0264	0.2026
F5	0.6457	1.8954	7.4943	0.8490	2.2242	7.9377	1.4947	4.1196	15.4319	-7.2919	-0.3288	6.6453	5.9100	-0.2804
F6	0.6221	1.7961	7.0721	0.7309	2.0546	7.5840	1.3530	3.8507	14.6561	-6.9619	-0.2586	6.3412	5.5939	-0.2398
F7	0.7547	2.0921	7.9773	0.8186	2.1982	8.1473	1.5733	4.2904	16.1246	-7.3926	-0.1061	7.1587	6.1346	-0.0950
F8	0.9592	2.4491	8.4188	0.8032	2.1893	8.0482	1.7624	4.6385	16.4670	-7.0890	0.2598	7.6156	6.4358	0.2168
F9	0.7386	2.0675	7.9608	0.8327	2.2058	7.9105	1.5713	4.2733	15.8713	-7.1719	-0.1383	7.1281	6.0865	-0.0859
F10	0.6724	1.9062	7.4687	0.6522	1.8851	7.2711	1.3246	3.7912	14.7398	-6.5987	0.0211	6.8165	5.5628	0.0419
F11	0.6597	1.9221	7.4700	0.6875	1.9734	7.7905	1.3472	3.8955	15.2604	-7.1307	-0.0513	6.7825	5.7162	-0.0819
F12	0.5947	1.8043	7.0338	0.6375	1.8757	7.4082	1.2322	3.6801	14.4420	-6.8134	-0.0714	6.3963	5.4307	-0.1048
F13	0.8308	2.2238	8.0419	0.7605	2.1047	7.8646	1.5913	4.3285	15.9065	-7.0338	0.1191	7.2814	6.1309	0.0996
F14	0.9299	2.3773	8.2702	0.6758	1.9543	7.4415	1.6057	4.3317	15.7117	-6.5116	0.4230	7.5944	6.1062	0.3907
F15	0.6721	1.9222	7.4236	0.6045	1.8224	7.2919	1.2766	3.7445	14.7156	-6.6198	0.0998	6.8191	5.5221	0.0832
F16	0.7488	2.0847	7.7681	0.6683	1.9194	7.3291	1.4171	4.0042	15.0973	-6.5804	0.1653	7.0998	5.7733	0.1666
F17	0.6778	1.9623	7.8530	0.7179	2.0308	7.7959	1.3958	3.9930	15.6489	-7.1181	-0.0685	7.1351	5.8456	-0.0382
F18	0.6173	1.8559	7.4528	0.8920	2.3231	8.2649	1.5093	4.1790	15.7176	-7.6476	-0.4672	6.5608	5.9939	-0.4201

Based on the values of D+R and D-R, the impact results are shown in Table 6. The challenging factors are categorised into cause-and-effect groups.

Table 6 Impact results of factors

Factors	D+R	D-R	Impact
F1	5.9178	0.1340	Cause
F2	6.0176	0.2723	Cause
F3	5.6146	-0.3097	Effect
F4	6.0264	0.2026	Cause
F5	5.9100	-0.2804	Effect
F6	5.5939	-0.2398	Effect
F7	6.1346	-0.0950	Effect
F8	6.4358	0.2168	Cause
F9	6.0865	-0.0859	Effect
F10	5.5628	0.0419	Cause
F11	5.7162	-0.0819	Effect

F12	5.4307	-0.1048	<i>Effect</i>
F13	6.1309	0.0996	Cause
F14	6.1062	0.3907	Cause
F15	5.5221	0.0832	Cause
F16	5.7733	0.1666	Cause
F17	5.8456	-0.0382	<i>Effect</i>
F18	5.9939	-0.4201	<i>Effect</i>

The cause-effect diagram is presented to plot the cause and effect challenging factors shown in Figure 2.

Fig. 2 Cause and effect diagram

5. Discussion of Findings

The F-DEMATEL results in the causal and effect factors categorisation. Based on the D-R values, the categorisation is done. The factors F1, F2, F4, F5, F10, F13, F14, F15 and F16 are cause group factors as they have positive D-R values. This shows that these factors influence the other factors and are critical for the organisations to take care of. The challenging factors- investment decisions require up-front certainty (F1), third party involvement (F2), automation landscape insufficiently mature (F4), non-availability of skilled people (F8), structural impediments (F10), lack of shared value (F13), skepticism towards the new way of working (F14), lack of investment (F15), misunderstanding agile concepts (F16) are categorised as causal group factors.

The readiness of the organisation is significant in adopting agile transformation. The organisations should avoid waste including investments on new projects that has uncertainty and non-guaranteed ROI. With the agile project implementation organisations take this uncertainty as an opportunity to experiment and bring change reduced cost. Investment decisions require up-front certainty (F1) is in line with the previous research that suggests companies are reluctant towards agile project implementation as it may not bring returns or unexpected results (Djödin et al., 2020; Tsoy and Staples, 2020). Many companies lock their structure into fixed-price or fixed-outcome contracts

and thus working with stakeholders who can't or won't adapt agile projects will jeopardise its success (Holden and Azar, 2021; Shastri, et al., 2021).

Agile project implementation needs automation. But lack of automation adopted by the Indian organisations create struggle to cope with the agile transformation. However, understandably, no organisations anticipated or planned for a crisis with the broad scale operational impact of COVID-19 (Koch and Schermuly, 2021; Malik, et al., 2021). This has created the negative impact on the mental state of the employee and lower down their motivation and morale. The agile project implementation is not limited to the technical transformation but a cultural adaptation too. It requires a change whereby organisations open their doors for adoption new skills, processes and technologies. If the organisation becomes rigid with the culture, roles and traditional approach for working, it may not allow the agile team which has the capability to solve a problem (Koch and Schermuly, 2021; Niederman, 2021). Several pre-existing conditions hinder the implementation of agile projects (Narkhede et al., 2020).

The most significant causal factor is skepticism towards the new way of working (F14) that has highest value (0.3907). Management acknowledges the benefits of agility but opposes its implementation. This aligns with the previous research where skepticism had raised due to misconceptions, including that agile does not work for complex products (Zasa et al., 2021). This reluctant perception keeps the firms and employees to adopt the transformation.

Based on the impact results, negative values of D-R, loss of control (F3), less motivation and enthusiasm due to COVID-19 impact (F5), projects take too long to get going (F6), governance processes remain slow (F7), risks are not actively mitigated (F9), Lack of clarity around roles (F11), change resistance (F12), coordination challenges in multi-team environment (F17), requirement's ambiguity affects quality (F18) are categorised as effect group factors. These factors get influenced by the casual group factors.

Due to agile projects, the control is distributed among the team which may annoy the stakeholders (Lill and Wald, 2021). The influence of the causal group factors may create the feeling of loss of control as the challenge to avoid implementation of agile projects. Several aspects of agile

transformation may develop challenges that can't be resolved by conventional means (Nuottila et al., 2016).

Agile project implementation is hampered by indecision and inability of organisation to take prompt decision (Ragas and Ragas, 2021). Agile requires far more active risk management as compared to the traditional models, a risk log and monthly meetings were set up to review risks and take actions for mitigating the most urgent ones. Agile project focuses on team roles that may create ambiguity in the job roles. These projects need to be implemented with concepts and planning but due to lack of clarity it sometimes misleads the project managers. Many examples of problems had been seen by misconceptions related to agile software development. Generally, the agile manifesto is not properly understood and practices were conducted without understanding the real purpose (Sithambaram et al., 2021). There are challenges of coordination among the team members which restricts to implement agile projects (Hoda and Murugesan, 2016). In context to requirements engineering, agile projects may need to be extended to accommodate additional testing activities. The inability to extend the testing may create problems for agile project implementation (Rindell et al., 2021).

5.1 Theoretical Contributions

This study contributes to agile project implementation and impact of several challenging factors. In contingency theory view, no generalised path is towards success or failure. This study is appropriate in elaborating that several challenging factors are responsible for agile project implementation. Firstly, it makes an understanding of the agile project implementation challenges existing in emerging economies. However, the initiatives for inclusion of industry 4.0 technologies undertaken by the government of India but still the implementation is very low due to several challenges like - skepticism towards the new way of working, non-availability of skilled people, third party involvement, automation landscape insufficiently mature, misunderstanding agile concepts etc. There is limited research on agile project implementation and its challenges in context to India. The exploration of these challenging factors will support researchers to understand the key issues affecting the implementation of project. Secondly no study has categorised the challenging factors into causal and effect to explore its nature. By F-DEMATEL method, the study has grouped the challenging factors into cause and effect. Furthermore, each factor influence is calculated and its interrelationship with other factors. Finally, this study fills the gap on limited

research on agile project implementation. This study provides insights for managers and policymakers to plan strategic actions for agile project implementation in emerging economy like India. The study acts as a steppingstone in the theoretical development of agile project implementation for future cross-sectional research.

5.2 Managerial Implications

The current study determines the cause-and-effect relationship among the challenging factors, and therefore provides opportunities for the project management teams to improve their current systems. It also helps policymakers and the decision makers to take initiatives for developing the agile projects. As per the findings the influential causal factors are - Investment decisions require up-front certainty (F1), third party involvement (F2), automation landscape insufficiently mature (F4), less motivation and enthusiasm due to COVID-19 impact (F5), non-availability of skilled people (F8), structural impediments (F10), lack of shared value (F13), skepticism towards the new way of working (F14), lack of investment (F15), and misunderstanding agile concepts (F16). These factors have high influence on all other factors and thus project managers must focus on these to implement agile projects successfully. The managers may be benefitted from this study to consider these factors and make efforts to get rid of these challenges for agile project implementation in emerging economies like India. Thus, this study contributes to assess the influencing and the influenced factors for agile project implementation.

For majority of the organisations, the question for adopting digital development for enhancing the quality is not to be raised but how and to which extent needs to be planned. Agility is one of the key enablers for keeping the pace and customer centricity and means of fundamental shift. The transformation ranges from structural changes, governance to capabilities, technological transformation, sourcing, people, culture, and performance. These areas are optimised to enhance focus, speed, and flexibility, transparency, predictability and control, with reduction in the cost.

This study suggests that the skepticism among the employees is the main challenging factor that inhibits agile project implementation. Project manager must consider formalising specialised roles, such as testing manager to drive rigor and alignment for test plans, tools, and data; build master; or even a traditional project manager to avoid the challenges reacted to job role, shared values, Project managers should also focus on training to enhance the skills of the team members and

increasing the adaptability for the future. The skepticism for the adaptability must be taken care of urgently as most of the organisations are struggling with the disruptive environment and need to shift to the automation, agility to survive in the post pandemic situation.

6. Conclusions, Limitations and Future Research

The situation during COVID-19 has created disruptive environment across the globe affecting every institution and individual. The inclusion of artificial intelligence, data science and other industry 4.0 technologies have transformed the existing systems and demonstrated the need of agility. During disruption, the resources need to be optimised for developing capabilities and building agility. This study aimed at identifying challenges faced by the firms to adopt and manage agile projects in emerging economies where the resources are limited. The present research evaluates the challenges to agile project management during COVID-19 and establish relationship among those factors using F-DEMATEL. This study offers opportunities for managers to decide how agile projects could benefit firms to deal pandemic situation in future.

The lessons from the COVID-19 enable the organisations to realise the need of preparedness for a 'new normal' situation. With the help from this paper, the critical factors are explored that must be considered for enhancing agility in the project management implementation during pandemic. This research approach is certainly in line with the increasing trend towards pandemic and new normal situation. The results of this study show skepticism towards the new way of working (F14) and third-party involvement (F2) are the most critical factors that must be considered to improve the agility in the projects.

This research study has few limitations that are required to be highlighted for future similar studies to consider. The identification and finalisation of factors is very challenging. The dynamic environment will develop more factors to be considered in near future. Thus, the study has identified 18 critical factors which may increase in future. The study has assessed the factors based on expert from one country and thus the study may be replicated to the other countries with the similar conditions. The study has investigated cause-and-effect group analysis using F-DEMATEL which may be further assessed through empirical analysis.

Declarations

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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