

Conceptualizing Team Adaptability and Project Complexity: A Literature Review

Derek A. Abankwa, Steve Rowlinson, and Emmanuel Adinyira

Abstract—Construction projects are usually laced with ambiguities and uncertainties that make them increasingly complex in today's fast changing world. Team adaptability as an organizational behavior is considered an important quality for success in such uncertain project environments yet it remains largely unexplored in a construction context. This notable absence is perhaps partly due to the general unwillingness to focus on individual psychology, as the industry seems infatuated with process efficiency. A team's ability to be adaptive to change and quickly respond during make-or-break moments in construction projects is considered vital for project management. Drawing on an extensive review of academic literature on organizational behavior we propose that the complex nature of the construction project itself, in turn, plays a role as a moderating factor on team adaptability. Conclusions are drawn highlighting the significance of team adaptability in complex projects and proposing future research areas.

Index Terms—Antecedents, construction projects, project complexity, team adaptability.

I. INTRODUCTION

Construction projects are laced with uncertainties and ambiguities making projects tremendously risky and difficult to manage. These uncertainties have often been related to the complex nature of projects in today's fast-changing world [1]. Reference [2] mentions that the presence of the numerous activities that are interdependent on each other in several ways contributes to making construction projects complex. These interdependent activities create a system where it is usually difficult, and sometimes impossible to foresee and address uncertainties at the outset of a project. Project complexities such as incomplete documentations or advanced technologies may force changes in project objectives which can affect the overall goal of the project. If these changes are critical, it may cause consequential delays in project schedule, and increase demand for equipment, materials, and labor.

An increasing number of studies have sought to address the issue of project complexity. However, in addressing project complexity, construction management literature has often considered communication [3], [4], inadequate coordination [5], site restriction [6], systems of procurement [7], complex

designs [6], methods of construction [8], "dispersion of project teams [9] and several others. Researchers have mostly considered the dominant operations paradigm at improving project objectives without devoting significant attention to organizational behaviors - in situations of project complexity - which is concerned with what people do and how their behaviors affect the organizations performance [10]. This notable absence could probably be as a result of the general reluctance of the industry to emphasize on individual psychology or psychological research but seems consumed with desire for process efficiency. Stakeholders in construction recognize the inevitability of change due to project complexities hence a premium is placed on adaptability as a way to survive amidst such disruptions. Adaptability reflects the capability of restraining the effects of uncertainty by taking advantage of available opportunities. This concept occurs at various levels; however, team adaptability has been proposed for multicultural or temporary environments [11]-[13]. This is not surprising due to the novel demands associated with increased use of teams to accomplish work, changes in technology, diversity in the work force and other challenges at the work place [14]. Construction teams are mostly known to be formed or reorganized for new projects therefore focusing on an organizations' individual capability could result in teams working towards individually defined objectives.

The concept of team adaptability is even more relevant in construction projects looking at the features of the industry such as its project-based nature where every project is usually somewhat unique; being highly fragmented; having multiple stakeholders; and the current shift to digital technology. Ironically, team adaptability remains largely unexplored in the context of construction management even though [15] have indicated that adaptability is an essential human quality in complex and uncertain environments. Team adaptability may be described as the process of addressing contingencies in the environment, making necessary changes to address new circumstances and challenges, as well as regulating plans, actions, and priorities in response to changing and unpredictable situations [16]. According to [17], the effectiveness of a person's response to new demands resulting from new and often ill-defined problems created by uncertainty, complexity and rapid changes in the work situation shows one's ability to adapt.

Ref. [18] realized that the complexity of an organization projects moderates the relationship between its degree of project management and the success of its projects. They again added that implementing projects is liable to all kinds of external influence, unanticipated events, varying constraints and changing flow of resources and that the complexity of an

Manuscript received November 30, 2018; revised January 13, 2019. This work forms part of a PhD Research Project which is fully supported by the University of Hong Kong Postgraduate Scholarship from the University of Hong Kong.

D. A. Abankwa and S. Rowlinson are with the Department of Real Estate and Construction, Faculty of Architecture, The University of Hong Kong, Pokfulam Road, Hong Kong (e-mail: derekpg@hku.hk, hrecsmr@hku.hk).

E. Adinyira is with the Department of Building Technology, Kwame Nkrumah University of Science and Technology, Kumasi-Ghana (e-mail: eadinyira.feds@knust.edu.gh).

organizations' project is a determining factor to a company-specific optimal level. Ref. [19] describes project complexity as any project feature that makes it difficult to comprehend, foresee and keep in check its entire behavior amidst reasonable and comprehensive information about the project system. We, therefore, consider that project complexities, in turn, plays a moderating role in the team adaptability process.

This paper seeks to build on this literature set by focusing on team adaptability and drawing on an extensive review of academic and industrial literature on organizational behavior in terms of project management and organizational change.

II. OVERVIEW OF ADAPTABILITY

Reference [20] first proposed the concept of adaptability. Since then, a great contribution has been provided to the understanding of adaptability over the second half of the 20th century by way of developing literature on organizational adaptation [21], [22]. Adaptability may broadly be defined "as an effective response to an altered situation" [23] p. 2. Adaptability offers dynamic abilities such as being able to anticipate problems, keeping up with changes and considering new ways of doing things, coping with crises and adjusting quickly to changes. Adaptation could be spontaneous (ad hoc) or planned and be carried out in response to or in anticipation of changes in conditions [24]. Adaptability or adaptation has mostly been used in the construction industry to mean "adopting" products, services or processes, or how the building structure itself adapts to its external environment. This represents ideas the construction industry adopts with the aim of enhancing productivity which is evidently realized in the adaptation of Building Information Modelling [25], workforce planning [26], new technology, and lean production. The concept of adaptability as the capability to modify behavior according to the requirements of new environments, events or situations, lacks in construction related research.

Adaptability has often been compared to constructs such as agility, vulnerability, transformation and resilience. Agility for instance refers to an organizations ability to adapt to shifting environments [27]. Vulnerability identifies key concepts such as adaptive capacity, persistence, coping and stability which are sometimes engaged in explaining the notion of adaptability. All these concepts indicate adaptability to change that exists outside the boundaries of a unit, however, the level of analysis differs. In applying these constructs, one should be mindful of the context in which they are used [28].

III. TEAM ADAPTABILITY

Theoretical and empirical work on adaptability over the last fifteen years has aimed at providing better understanding of the role and implications of adaptability in relation to teamwork [11], [29], [30]. Team adaptability provides the capability to be flexible, to consider additional information and appropriately respond during make-or-break moments in construction projects. According to [31], team adaptability is a continuous improvement of team processes to address

contingencies, make necessary changes to meet new circumstances, and regulate plans and actions in response to unpredictable situations. To this, [32] describes team adaptability as the functional change in response to altered environmental contingencies and a higher order process that emerges from an integrated set of individual attributes. Ref. [33] refer to team adaptability as a metamorphic shift in the team network in the short term to deal with the performance demands of a routine task. The concept of team adaptability is evidenced in the development or modification of capabilities, structures, cognitive activities and behaviors [16] in the face of uncertainties.

The construction industry is characterized as being a multicultural environment and according to [13], in such an environment team adaptability is necessitated. This study considers team adaptability since we believe the team is likely to be the first respondents to uncertainties that might create changes at the project-level. According to [16], structuring work through teams primes them to be more adaptive because collectives possess a larger range of experiences and capacities to rely on when occupied with performance change. The concern for practitioners and researchers interested in the domain of change is how well people can best anticipate and respond to change in a sustainable manner.

Reference [34] further suggested that team adaptability facilitates the relationship between teams' competences and their performance.

IV. OPERATIONALIZING TEAM ADAPTABILITY

Ref. [16] operationalized team adaptability as an outcome of team performance. Team adaptability is often operationalized as a team competence in adjusting to team strategies [35]. This study agrees with [34] and consider team adaptability as a process that unfolds during teamwork. Table I shows some various ways by which the concept team adaptability has been considered.

Some authors have measured team adaptability using experience-based structured interviews, assessment exercises and simulations, situational judgement tests (SJT's) [36]. Reference [37] used a decision-making simulation team adaptability where a team's pre-change and post-change performances were captured. By operationalizing team adaptability, [38] captured bottom-up changes in team performance, captured top-down changes in strategy, and profile of team adaptation over time. Standardized questionnaires with multiple constructs could also be used to measure team adaptability as demonstrated in [34].

There is, however, a lack of measurement for team adaptability in construction related contexts. For the purposes of this study, an exploratory study by way of semi-structured interviews will be organized to first establish the meaning of team adaptability to construction professionals. The exploratory study is to provide in-depth knowledge of what facilitates change and how project teams adapt to these changes. This is done to build a rich picture of the concept by capturing knowledge from practice. The following sections details out antecedents and processes of adaptability.

TABLE I: MEASUREMENT OF TEAM ADAPTABILITY

Dimensions	Predictors	Source
Solving problems creatively, Handling unpredictable work situations, Learning, interactions across team boundaries, Work stress, Emergencies or crises	Individual adaptability, Motivation and Attitudes, Mental models, Experience, Heterogeneity, Leadership, Team type	Pulakos, Dorsey, White 2015
Empathy, Active listening, Communication, Decision making, Envisioning	Team leadership, Team motivation	Burke, Hess, Salas 2015
Communication, Leadership, Monitoring, Team learning, Cue recognition, Team innovation	Team expertise, Task expertise, Mental models, Team orientation	Rosen <i>et al.</i> 2011
Offering a range of services during project work, Flexibly adjusting the project focus, Customizing solutions to problems	Behavioral competence, Task competence, Task-specific competence, Task-generic competence	Klarner <i>et al.</i> 2013
Situation assessment, Plan formulation, Plan execution, Team learning	Individual characteristic (knowledge, traits, cognitive ability), Team composition, Job characteristics, Shared mental models, Situation awareness, Psychological safety	Stagl <i>et al.</i> 2015
Handling work stress, Creatively solving problems, Learning work tasks and technologies, Interpersonal adaptability	Goal difficulty, Cognitive ability, Goal orientation, Role structure	LePine 2005

V. ANTECEDENTS OF TEAM ADAPTABILITY

A. Job Design

Job design considers the level of autonomy teams have during decision-making or coordinating activities. Groups that successfully cultivate adaptability typically permit members to express themselves in wide-ranging behaviors, and this freedom of expression helps groups explore divergent solutions to a problem [39]. It is deduced that jobs designed to empower and enable teams with the flexibility of making instantaneous decisions enhances adaptation. This is very essential since as teams have control over its own functions, there is the chance to modify its processes and strategies when necessary. A team seeking to adapt well on a project could for instance practice motivational job design approach as this can increase autonomy, skill usage, participation, feedback, recognition and achievement.

B. Team Leadership

Team leaders serve as coordinators of operations, as liaisons to external teams or management, and as guides for setting the teams vision [40]. Team leaders play a key role in facilitating a team's propensity to adapt by choosing how and when to intervene to promote review and revision of

procedures and methods [41]. According to [42], team leaders who engage in participative leadership have team members who generate more problem solutions than leaders who display directive leadership. Team leaders guide the team and define directions that would maximize progress of the team in situations of adaptability.

C. Team Motivation

Generally, the source of team motivation would depend on a number of factors such as the type of work involved, resources available, compensation or even the type of leadership. A team that has an elevated level of motivation is likely to thrive during setbacks. Motivation through reward systems can support change and encourage teams to accept and acquire the necessary skills in line with the changing nature of the project. A well-designed reward system could therefore be a way of promoting adaptability in project teams.

D. Team Experience

Team or individual's prior experience and expertise with similar or varying circumstances and uncertainties in projects increases the different solutions provided to a similar problem encountered. Project team members need team related skills or knowledge to readily coordinate with others. The ability to coordinate is essential for adaptability in a dynamic work environment. This reveals that teams comprised of knowledgeable individuals who share mutual understanding of team capabilities are likely to perform adaptively.

E. Individual Characteristics

The team consists of individuals who would have to integrate their individual actions in situations of adaptability. The effectiveness of the team to adapt would be underpinned by adaptable characteristics of individuals in the team hence, focusing on the ability of individuals and how their adaptation is coordinated at the team level could lead to an enhanced understanding of team adaptability. Team member's individual differences should serve as both direct and indirect determinants. The direct determinants are the relevant knowledge on the job and individual's skill set [43] whereas the indirect determinants refer to cognitive abilities, attitudes and traits [44]. Reference [40] suggests that adaptive teams will be composed of individuals with high levels of task expertise, team expertise, team orientation, openness to experience, and cognitive ability. These individual characteristics can be seen to affect adaptability by predisposing individuals to perceive more or less when faced with new, changing or stressful situations. Studies on team management in the construction industry shows that it is critical to maintain control over relationships between team members whose personalities vary and have diverse professional and nonprofessional knowledge or skill since the performance of each contributes to collective success. Trust between team members is necessary as it ensures the willingness of sharing experience without fear of being disparaged.

VI. TEAM ADAPTABILITY PROCESS

Adaptability is critical as it involves unforeseen problems

and dealing with change when things go wrong as they suddenly and very often occur in construction projects [45]. Reference [16] generally identifies situation assessment, plan formulation, plan execution, and team learning as processes of team adaptability. However, the temporary organizing and complex nature of the construction industry such as project teams being affiliated to different organizations especially during project execution hinders the process of team adaptability. It is therefore appropriate to investigate the team adaptability process in project organizations especially during the construction phase of a project where project changes manifest rapidly.

A. Situation Assessment

Situation assessment is the first step in an adaptability process, and this comprises the human process of gathering information (attention, recognizing patterns and communication) [46]. Adaptability is triggered when changes occur hence, cues in the environment that might or has affected the mission of the team have to be identified. Reference [47] offers instances where teams are likely to identify cues. He mentions a situation experienced as novel or unusual, an unexpected failure or discrepancy, and a deliberate initiative which calls for an increased level of conscious attention to a cue. A further study by [48] also identified critical incidents, and the associated cues used as basis of sense making in project-related situations. Meanings are then assigned to these cues and communicated among team members to generate shared understanding (mental models).

As elements of project complexity such as novelty in technology [7], unpredictable changes in client requirements and high uncertainty [49], increases, situation assessments can have more limited use which means detecting early cues or changes in projects could fall on team member's "gut feeling". Communication, experience and prior knowledge is increasingly important in this first stage of the process. The team leader or any member of the team draws on their cognitive ability to detect cues that signals a need for change.

B. Plan Formulation

Formulating a plan is essential to team adaptability as the recognized cue involves undertaking works that are unprecedented or have limited or no historical documentation. The project team selects a course of action, set goals, specify member responsibilities, identify environmental constraints, prioritize tasks and share information that is related to the requirements of the task [50]. This plays into a team's psychological safety characterized by mutual respect and interpersonal trust which makes it possible for team members to speak up and offer contributions during the development of a plan. Shared mental models manifested from situation assessment coordinates team's actions implicitly and the shared understanding of the current situation enables the team assign correct meanings to cues in the context of team's goals.

Ref. [7] determined planning, co-ordination and control requirements in highlighting the importance of project complexity to project management. Inherent complexity such as roles that have no known procedure, roles managed for the first time and overlap of phases [6] could bring some pressure

to bear on an adaptable team, formulating a plan to address uncertainties. A team that adapts well cannot overcome a poorly designed plan. Likewise, a team poor at adapting to changes could sabotage the best of plans. Meaning planning alone is not enough in the adaptability process but considering the team's psychological safety since the project team implements, controls and when necessary, correct the project plan to meet specific objectives.

C. Plan Execution

Executing the plan calls for communication and coordination of actions. Ref. [51] opine that coordination is a team level phenomenon which involves the team establishing sequence and time of its activities or actions. In addition to sequence and timing of activities, plan execution considers individual level behaviors such as monitoring and backup behaviors [16]. This makes it possible for team members to observe actions of others by watching out for lapses with the intent of correcting them in an opportune moment. Team members should consider themselves as a unit with clear identity thereby accepting responsibility and holding each other liable for executing the plan. Reference [52] mention that when underutilized individuals back up the individual whose capacity is being surpassed, teams can dynamically adjust and perform at a level that could not have been otherwise achieved by individuals acting alone. It is suggested that team leadership is an essential factor in plan execution as project leaders mostly set up processes that structures the activities of team members.

The challenge of executing the plan and ensuring monitoring or backup behaviors in construction projects is requiring different trades to work in close proximity at the same time. Project complexity is seen in physically difficult roles that require the use of complex equipment; interdependencies between roles of various technologies in a task; decision-making; "dispersion" of project teams [7], [6] can influence the efficient execution of a task.

D. Team Learning

According to [53], learning is a process whereby knowledge is accumulated through testing assumptions, discussing differences, adjusting strategies in response to new conditions and forming new routines. This is useful in team adaptability since members learn adaptable behaviors from previous projects and apply it to future projects when the need arises. Reference [54] indicates learning as a strategy to cope with complexity. Team learning contributes to the ability of team members to develop knowledge and collectively improve understanding of a given situation. In project-based organizations, it is realized that a significant portion of learning happens within project teams [55]. Learning, teamwork and knowledge management has been related to the social aspects of project complexity [56]. The knowledge acquired from adapting to situations in previous projects will help members scan future project environments for cues or changes. Ref. [55] explored issues of project team learning and found that, poor knowledge communication and leadership role are the true motives behind failure to learn. Regardless of the importance of team learning in the adaptability process, construction projects are by nature

temporal and it is likely that learning generated in a project might disappear at the completion of the project without established processes or procedures to gather and disseminate knowledge.

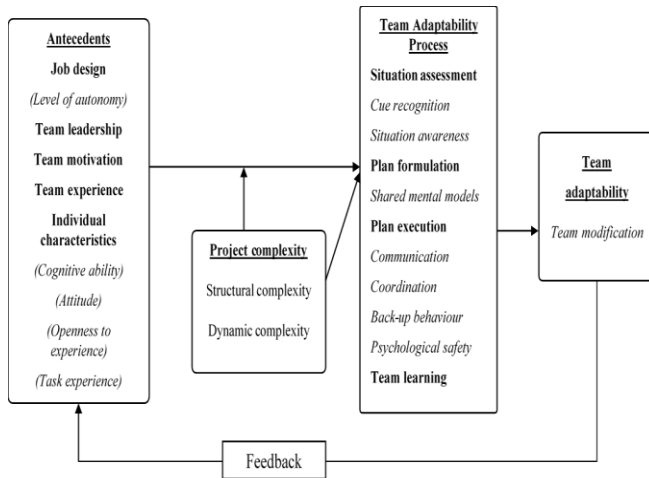


Fig. 1. Conceptual framework for team adaptability and project complexity.

VII. INFLUENCE OF PROJECT COMPLEXITY

Complexity is always present in the development of projects because of issues related to globalization, modern technologies, fragmented supply chains, and the demand to deliver more ambitious and costlier projects [57]. These complex issues could pose challenges in managing project teams. According to [58], the physical or social factors of the environment can affect behaviors of people.

Several studies have classified complexity as either structural or dynamic in nature [59]-[62]. Structural complexity considers the size or number of components and interrelations of project elements. Some examples of structural complexity are vertical differentiation, project size, and spatial differentiation [63]. Dynamic complexity involves changes among the components and interrelations of elements over time. This includes availability of resources, extent of system redesign, and the extent of goal and scope changes [64]. A review of studies on project complexity in the last 50 years by [56] relates project complexity to the following:

- 1) Organizational structure and dynamics
- 2) Organizational adaptability and learning
- 3) Uncertainty and ambiguity
- 4) Complex engineering projects
- 5) Collaborative new product development teams
- 6) Scheduling, and resource allocation
- 7) Innovation and system dynamics
- 8) Socio-political and knowledge integration
- 9) Novelty and project size

Based on the review, they argued that focus is changing from project control to project adaptability when dealing with complex projects, and it is necessary to develop capabilities to manage and cope with project complexities. The assumption of using capabilities to manage project complexity underline the notion that project complexity is not a condition that can be analyzed in isolation. Conversely, project complexity is a

condition in which the perception of it depends on the capability of the structure put in place to manage it, and this capability also depends on the perception of project complexity, resulting in interactive feedback between project complexity and capabilities.

Project complexity creates new prospects in its emerging properties that can influence the success of projects negatively. Ref. [65] relays the success of projects to project performance and its related project complexity. Intuitively, we expect project complexity to have direct or indirect influence on team adaptability. During project management, it is better to understand complexity in project context.

VIII. CONCLUSION

Construction is a nonlinear, complex and dynamic phenomenon, which often exists on the edge of chaos. Several studies have shown how project complexity affects the success of projects. Given the continuous change in technology, it is imperative that employees acquire the willingness to involve themselves in learning new procedures to deal with change in an effective manner. The concept of adaptability is important for construction project teams especially in uncertain project environments as it involves coping with emergencies or crises, handling unpredictable and uncertain work situations, learning new procedures and new tasks, dealing with work stress, solving problems creatively, expressing physically oriented adaptability, demonstrating interpersonal adaptability, and establishing cultural adaptability. The importance of team adaptability has been established in other fields or industries, yet it is less considered in complex and uncertain environments like construction projects. Despite the increasing recognition of team adaptability among researchers, it appears that there are no clear systematic and integrated training or research programs on team adaptability in the construction industry. Through this paper, we have started to unpack the concept of team adaptability in construction projects. We recognize that, the discussions made above may not be the full range of mechanisms since this only forms a baseline for further development of the construct in construction context. This research agenda creates a point of departure for practical and theoretical propensities to place team adaptability in construction project management. Future research is required on how to properly and practically measure team adaptability in construction projects considering the nature of project teams. Another direction of research is to consider how the nature of organizational context and institutions affects team adaptability, and what leadership style works best for an adaptable team. This will surely open up the complexities involved in the team adaptability process.

ACKNOWLEDGMENT

D. A. Abankwa thanks Selorm Emmanuel Adukp (Department of Real Estate and Construction, HKU) for his constructive comments that further shaped the structure of this work.

REFERENCES

- [1] T. A. Nguyen, L. D. Nguyen, L. Le-Hoai, and C. N. Dang, "Quantifying the complexity of transportation projects using the fuzzy analytic hierarchy process," *International Journal of Project Management*, vol. 33, pp. 1364-1376, 2015.
- [2] T. R. Browning, "Managing complex project process models with a process architecture framework," *International Journal of Project Management*, vol. 32, no. 2, pp. 229-241, 2014.
- [3] R. Senescu, G. Aranda-Mena, and J. Haymaker, "Relationships between project complexity and communication," *Journal of Management in Engineering*, vol. 29, no. 2, pp. 183-197, 2013.
- [4] S. A. Leybourne, V. Kanabar, and R. D. H. Warburton, "Understanding and overcoming communications complexity in projects," presented at PMI GLOBAL Congress, Washington, DC, Project Management Institute, 2010.
- [5] Q. Yang, S. Kherbachi, Y. S. Hong, and C. Shan, "Identifying and managing coordination complexity in global product development project," *International Journal of Project Management*, vol. 33, no. 7, pp. 1464-1475, 2015.
- [6] H. Wood and P. Ashton, "Factors of complexity in construction projects," in *Proc. 25th Annual ARCOM Conf. Nottingham, UK. Association of Researchers in Construction Management*, A. Dainty, Ed. 2009, pp. 857-866.
- [7] D. Baccarini, "The concept of project complexity - A review," *International Journal of Project Management*, vol. 14, pp. 201-204, 1996.
- [8] K. Gidado, "Project complexity: The focal point of construction production planning," *Construction Management and Economics*, vol. 14, pp. 213-225, 1996.
- [9] A. Dainty, D. Moore, and M. Murray, *Communication in Construction: Theory and Practice*, Oxford: Taylor & Francis, 2006.
- [10] S. J. Motowidlo, "Job performance," in *Handbook of Psychology*, W. C. Borman, D. R. Ilgen, and R. J. Klimoski, Eds. New Jersey: John Wiley & Sons, 2003, vol. 12, pp. 39-64.
- [11] S. W. J. Kozlowski and B. S. Bell, "Team learning, development, and adaptation," in *Group Learning*, V. I. Sessa, M. London, Eds. Mahwah, NJ: LEA, 2008, pp. 15-44.
- [12] L. G. Pierce, "Barriers to adaptability in a multinational team," in *Proc. 46th Annual Meeting of the Human Factors and Ergonomics Society*, 2002, pp. 225-229.
- [13] J. L. Sutton, L. G. Pierce, S. Burke, and E. Salas, "Cultural adaptability," *Understanding Adaptability: A Prerequisite for Effective Performance within Complex Environments*, vol. 6, pp. 143-173, 2006.
- [14] N. Schmitt and D. Chan, "Adapting to rapid changes at work: Definitions, measures, and research," in *Individual Adaptability to Changes at Work: New Directions in Research*, D. Chan, Ed. New York: Routledge, 2014, pp. 3-17.
- [15] S. A. Boylan and K. A. Turner, "Developing organizational adaptability for complex environment," *Journal of Leadership Education*, vol. 16, no. 2, pp. 183-198, 2017.
- [16] C. S. Burke, K. C. Stagl, E. Salas, L. Pierce, and D. Kendall, "Understanding team adaptation: A conceptual analysis and model," *Journal of Applied Psychology*, vol. 91, pp. 1189-1207, 2006.
- [17] D. Chan, "Understanding adaptation to changes in the work environment: Integrating individual differences and learning perspectives," in *Research in Personnel and Human Resources Management*, G. R. Ferris, Ed. New York: Elsevier Science, 2000, pp. 1-42.
- [18] A. J. Christoph and S. Konrad, "Project complexity as an influencing factor on the balance of costs and benefits in project management maturity modeling," in *Proc. 27th IPMA World Congress, Social and Behavioral Sciences*, vol. 119, pp. 162-171, 2014.
- [19] L. A. Vidal, F. Marle, and J. C. Bocquet, "Using a Delphi process and the Analytic Hierarchy Process (AHP) to evaluate the complexity of projects," *Expert Systems with Applications*, vol. 38, pp. 5388-5405, 2011.
- [20] B. Hesketh and A. Neal, "Technology and performance," in *The Changing Nature of Performance: Implications for Staffing, Motivation, and Development*, D. R. Ilgen, E. D. Pulakos, Eds. San Francisco: Jossey-Bass, 1999.
- [21] A. Y. Lewin and H. K. Volberda, "The future of organization studies: Beyond the selection adaptation debate," in *The Oxford Handbook of Organization Theory*, H. Tsoukas and C. Knudsen, Eds. Oxford, 2005, pp. 568-595.
- [22] M. Farjoun, "Beyond dualism: Stability and change as a duality," *Academy of Management Review*, vol. 35, pp. 202-225, 2010.
- [23] S. S. White, R. A. Mueller-Hanson, D. Dorsey, E. D. Pulakos, M. M. Wisecarver, and E. A. Deagle, "Developing adaptive proficiency in special forces officers," *ARI Research Report 1831, Army Research Institute for the Behavioral and Social Sciences*, Arlington, VA: U.S., 2005.
- [24] J. Tillson, W. Freeman, W. Bums, J. Michel, J. LeCuyer, R. Scales, and D. R. Worley, "Learning to adapt to asymmetric threats," *IDA Document D-3114, Alexandria, VA: Institute for Defense Analyses*, 2005.
- [25] S. Talebi, "Exploring advantages and challenges of adaptation and implementation of BIM in project life cycle," in *Proc. 2nd BIM International Conf. on Challenges to Overcome*, Lisbon, Portugal, 2014.
- [26] A. R. Fayek and J. Peng, "Adaptation of workforce planning for construction contexts," *Canadian Journal of Civil Engineering*, vol. 40, no. 10, pp. 980-987, 2013.
- [27] J. McCann, J. Selsky, and J. Lee, "Building agility, resilience and performance in turbulent environments," *People and Strategy*, vol. 32, no. 3, pp. 44-51, 2009.
- [28] K. Opping Banahene, A. Anvuur, and A. Dainty, "Conceptualizing organizational resilience: An investigation into project organizing," in *Proc. 30th Annual ARCOM Conference, Portsmouth, UK, Association of Researchers in Construction Management*, A. B. Raiden, E. Aboagye-Nimo, Eds. pp. 795-804, 2014.
- [29] S. J. Zaccaro, D. Banks, L. Kiechel-Koles, C. Kemp, and P. Bader, "Leader and team adaptation: The influence and development of key attributes and processes," Technical Report 1256, U.S. Army Research Institute for the Behavioral and Social Sciences, Arlington, VA, 2009.
- [30] S. Uitdewilligen, M. J. Waller, and F. R. H. Zijlstra, "Team cognition and adaptability in dynamic settings: A review of pertinent work," in *International Review of Industrial and Organizational Psychology*, G. P. Hodgkinson and J. K. Ford, Eds. Chichester, UK, 2010, pp. 293-353.
- [31] E. D. Pulakos, S. Arad, M. A. Donovan, and K. E. Plamondon, "Adaptability in the work place: Development of a taxonomy of adaptive performance," *Journal of Applied Psychology*, vol. 85, pp. 612-624, 2000.
- [32] P. J. Fleming, G. M. Wood, N. M. Dudley, P. K. Bader, and S. J. Zaccaro, "An adaptation training program for military leaders and teams," in *Mission Critical: Developing Adaptive Performance in US Army Special Forces*, E. D. Pulakos, Ed. Orlando.
- [33] S. W. J. Kozlowski, S. M. Gully, E. R. Nason, and E. M. Smith, "Developing adaptive teams: A theory of compilation and performance across levels and time," in *The Changing Nature of Performance: Implications for Staffing, Motivation and Development*, D. R. Ilgen and E. D. Pulakos, Eds. San Francisco, 1999, pp. 240-292.
- [34] P. Klamer, M. Sarstedt, M. Hoeck, and C. M. Ringle, "Disentangling the effects of team competences, team adaptability, and client communication on the performance of management consulting teams," *Long Range Planning*, vol. 46, pp. 258-286, 2013.
- [35] J. A. Cannon-Bowers, S. I. Tannenbaum, E. Salas, and C. E. Volpe, "Defining team competencies: Implications for training requirements and strategies," in *Team Effectiveness and Decision Making in Organizations*, R. Guzzo and E. Salas, Eds. Jossey Bass, San Francisco, 1995.
- [36] E. D. Pulakos, D. W. Dorsey, and S. S. White, "Adaptability in the workplace: Selecting an adaptive workforce," *Understanding Adaptability: A Prerequisite for Effective Performance within Complex Environments*, pp. 41-71, 2015.
- [37] J. A. LePine, "Adaptation of teams in response to unforeseen change: Effects of goal difficulty and team composition in terms of cognitive ability and goal orientation," *Journal of Applied Psychology*, vol. 90, pp. 1153-1167, 2005.
- [38] M. A. Rosen, L. B. Wendy, J. L. Wildman, B. A. Fritzsche, S. Eduardo, and C. S. Burke, "Managing adaptive performance in teams: Guiding principles and behavioral markers for measurement," *Human Resource Management Review*, vol. 21, pp. 107-122, 2011.
- [39] C. K. De Dreu and M. West, "Minority dissent and team innovation: The importance of participation in decision making," *Journal of Applied Psychology*, vol. 86, no. 6, pp. 1191-1201, 2001.
- [40] S. J. Zaccaro, A. L. Rittman, and M. A. Marks, "Team leadership," *The Leadership Quarterly*, vol. 12, pp. 451-483, 2001.
- [41] J. R. Hackman and R. Wageman, "A theory of team coaching," *Academy of Management Review*, vol. 30, pp. 269-287, 2005.
- [42] S. S. Kahai, J. J. Sosik, and B. J. Avolio, "Effects of leadership style and problem structure on work group process and outcomes in an electronic meeting system environment," *Personnel Psychology*, vol. 50, pp. 121-146, 1997.

- [43] J. P. Campbell and N. R. Kuncel, "Individual and team training," in *Handbook of Industrial, Work and Organizational Psychology*, N. Anderson, D. S. Ones, H. K. Sinangil, and C. Viswesvaran, Eds. London: Sage, 2001, pp. 272-312.
- [44] J. P. Campbell, R. A. McCloy, S. H. Oppler, and C. E. Sager, "A theory of performance," in *Personnel Selection in Organizations*, N. Schmitt and W. C. Borman, Eds. San Francisco, 1993, pp. 35-70.
- [45] D. Dvir and T. Lechler, "Plans are nothing, changing plans is everything: The impact of changes on project success," *Research Policy*, vol. 33, no. 1, pp. 1-15, 2004.
- [46] C. Gutwin and S. Greenberg, "The importance of awareness for team cognition in distributed collaboration," in *Team Cognition: Understanding the Factors that Drive Process and Performance*, E. Salas and S. Fiore, Eds. Washington, DC, 2004, pp. 177-201.
- [47] G. A. Okhuysen, "Structuring change: Familiarity and formal interventions in problem-solving groups," *The Academy of Management Journal*, vol. 44, no. 4, pp. 794-808, 2001.
- [48] E. M. P. Gacasan, M. W. Wiggins, and B. J. Searle, "The role of cues in expert project manager sensemaking," *Construction Management and Economics*, vol. 34, no. 7-8, pp. 492-507, 2016.
- [49] M. Sun and X. Meng, "Taxonomy for change causes and effects in construction projects," *International Journal of Project Management*, vol. 27, no. 6, pp. 560-572, 2009.
- [50] R. J. Stout and E. Salas, "The role of planning in coordinated team decision making: Implications for training," in *Proc. 37th Annual Meeting of the Human Factors and Ergonomics Society*, Santa Monica, CA, 1993, pp. 1238-1242.
- [51] M. A. Marks, J. E. Mathieu, and S. J. Zaccaro, "A temporally based framework and taxonomy of team processes," *Academy of Management Review*, vol. 26, pp. 356-376, 2001.
- [52] C. Porter, J. R. Hollenbeck, D. R. Ilgen, P. J. Ellis, B. West, and H. Moon, "Backing up behaviors in teams: The role of personality and legitimacy of need," *Journal of Applied Psychology*, vol. 3, pp. 391-403, 2003.
- [53] A. C. Edmondson, R. M. Bohmer, and G. P. Pisano, "Disrupted routines: Team learning and new technology implementation in hospitals," *Administrative Science Quarterly*, vol. 46, pp. 685-716, 2001.
- [54] M. T. Pich, C. H. Loch, and A. D. Meyer, "On uncertainty, ambiguity, and complexity in project management," *Management Science*, vol. 48, no. 8, pp. 1008-1023, 2002.
- [55] H. M. Gharaibeh, "Project team learning in mega projects: Are we truly learning the lessons?" *International Journal of Project Organization and Management*, vol. 8, no. 1, pp. 87-102, 2016.
- [56] L. B. Rezende, P. Blackwell, and M. D. P. Gonçalves, "Research focuses, trends, and major findings on project complexity: A bibliometric network analysis of 50 years of project complexity research," *Project Management Journal*, vol. 49, no. 1, pp. 42-56, 2018.
- [57] Project Management Institute, *Navigating Complexity: A Practice Guide*, Newtown Square, PA: Author, 2014.
- [58] H. J. Thamhain, "Managing teams in complex project environments," presented at PMI Research Conference: New Directions in Project Management, Montréal, Québec, Canada, 2006.
- [59] L. Luo, Q. He, E. J. Jaselskis, and J. Xie, "Construction project complexity: Research trends and implications," *Journal of Construction Engineering and Management*, vol. 143, no. 7, p. 04017019, 2017.
- [60] W. Xia and G. Lee, "Complexity of information systems development projects: Conceptualization and measurement development," *Journal of Management Information Systems*, vol. 22, no. 1, pp. 45-83, 2005.
- [61] S. Floricel, J. L. Michela, and S. Piperca, "Complexity, uncertainty-reduction strategies, and project performance," *International Journal of Project Management*, vol. 34, no. 7, pp. 1360-1383, 2016.
- [62] K. Remington and J. Pollack, "Tools for complex projects," *Surrey: Gower*, 2007.
- [63] D. S. Mileti, D. F. Gillespie, and J. E. Haas, "Size and structure in complex organizations," *Social Forces*, vol. 56, no. 1, pp. 208-217, 1997.
- [64] P. M. A. Ribbers and K. C. Schoo, "Program management and complexity of ERP implementations," *Engineering Management Journal*, vol. 14, no. 2, pp. 45-52, 2002.
- [65] A. P. Chan, D. Scott, and A. P. Chan, "Factors affecting the success of a construction project," *Journal of Construction Engineering and Management*, vol. 130, no. 1, pp. 153-155, 2004.



Derek A. Abankwa is a Ph.D candidate at the University of Hong Kong. Derek was awarded the B.Sc (construction technology and management) in June 2014 and the M.Phil. (construction management) in May 2016. He obtained both degrees at Kwame Nkrumah University of Science and Technology, Ghana.

He worked as a teaching assistant and a graduate research assistant in KNUST. In May 2018, he was invited to the University of Florida as a visiting research scholar to work on his research project with astute professionals in industry and academia. His current research interest is in individual and team adaptive performance, project complexity, change management, and construction safety.

Mr. Abankwa is a member of Chartered Institute of Building (SMCIOB), Royal Institution of Chartered Surveyors (SMRICS), and Ghana Institute of Construction (IGIOC).



Steve Rowlinson is a chair professor of construction project management at the University of Hong Kong. He obtained the B.Sc (civil engineering) in Nottingham University in 1977, gained the M.Sc (concrete structures) in imperial College, London in 1982 and was awarded the Ph.D. (construction project management) in Brunel University in 1988.

He lectured at Brunel University for a year and later moved to the University of Hong Kong where he has been working for the past 30 years. Under his supervision, 35 Ph.D students and 5 MPhil students have successfully completed their studies. In 2014, he was awarded the outstanding research student supervisor award. He is also a guest professor at Chongqing University, China. His research interest is in construction project management, building information modelling, construction safety, procurement and innovation.

Prof. Rowlinson is a chartered engineer (CEng) and a member of Royal Institution of Chartered Surveyors (FRICS), Hong Kong Institution of Engineers (MHKIE), and Institution of Civil Engineers (MICE).



Emmanuel Adinyira is a senior lecturer at the Kwame Nkrumah University of Science and Technology, Ghana. He obtained the B.Sc. (building technology) first class honors in 2003 and the Ph.D (building technology) in 2009 both from KNUST, Ghana.

He has worked on several projects and researched into a number of construction-related issues in Ghana and other West African countries.

He was invited to Loughborough University as a visiting scholar in 2006. He has directly been involved in the supervision of 10 Ph.D projects (4 completed, 6 on-going) and 11 MPhil studies. He served as a local supervisor for 2 international programmes in Saxion University of Applied Science, Netherlands, and Hochschule Fur Technik Stuttgart University of Applied Sciences, Germany. His research interest is in construction project management, construction risk and quality management, building services, and construction safety.

Dr. Adinyira is a member of Ghana Institute of Construction (MGIOC), Chartered Institute of Building (ICIOB) and International Society for Development and Sustainability (MISDS).