An Agile Enterprise Architecture Driven Approach to Enhance Communication in Geographically Distributed Agile Development

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Certificate of Original Authorship

I, Yehia Alzoubi, certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text. I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Yehia Alzoubi

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Dedication

I dedicate this work to my late father (1933-1992), may Allah bless his soul, who first taught me the alphabets of this life. Even after all these years, you are in my thoughts every day dad. I also dedicate this work to my unlimited love and support-my mum (A'ishah), may Allah give you healthiness and long life.

List of Publications

Book Chapters

Alzoubi, Y.I. & Gill, A.Q. 2016, 'An agile enterprise architecture-driven model for geographically distributed agile development', in D. Vogel, X. Guo, H. Linger, C. Barry, M. Lang & C. Schneider (eds), *Transforming Healthcare Through Information Systems*, Springer International Publishing, pp. 63-77.

Journal Articles

Alzoubi, Y.I., Gill, A.Q. & Al-Ani, A. 2015, 'Distributed agile development communication: an agile architecture driven framework', *Journal of Software*, vol. 10, no. 6, pp. 681-94. {Double-blind review; ERA ranked B journal}

Alzoubi, Y.I., Gill, A.Q. & Al-Ani, A. 2016, 'Empirical studies of geographically distributed agile development communication challenges: a systematic review', *Information and Management*, vol. 53, no. 1, pp. 22-37. {Double-blind review; ERA ranked A* journal}

Conference Proceedings

Alzoubi, Y.I. & Gill, A.Q. 2014, 'Agile global software development communication challenges: a systematic review', *In Proceedings of the 18th Pacific Asia Conference on Information Systems (PACIS 2014)*, p. 20. {Double-blind review; ERA ranked A Conference}

Alzoubi, Y.I. & Gill, A. 2015, 'An agile enterprise architecture driven model for geographically distributed agile development', *In Proceedings of the 24th International Conference on Information System Development (ISD 2015)*, Harbin, China. {Double-blind review; ERA ranked A Conference}

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List of Abbreviations

AMOS	Analysis of Moment Structures
ASD	Agile Software Development
CB-SEM	Covariance-Based Structural Equation Model
CFA	Confirmatory Factor Analysis
DSD	Distributed Software Development
DSDM	Dynamic Software Development
EA	Enterprise Architecture
EFA	Exploratory Factor Analysis
EM	Expectation Maximisation
FDD	Feature Driven Development
GDAD	Geographically Distributed Agile Development
HTMT	Hetero-Trait Mono-Trait
IS	Information System
IT	Information Technology
KSD	Kanban Software Development
LISREL	Linear Structural Relations
LSD	Lean Software Development
MAR	Missing Data at Random
MCAR	Missing Completely at Random
MIS	Management of Information System
MTMM	Multi-Trait Multi-Method
PLS	Partial Least Squares
RQ	Research Question
SD	Software Development
SEM	Structural Equation Modelling
SLDC	Systems Development Life Cycle
SLR	Systematic Literature Review
SPSS	Statistical Package for the Social Science
TDD	Test Driven Development
VAF	Variance Accounted for
VIF	Variance Inflation Factor
XP	Extreme Programming

Glossary

Item	Explanation	Reference
Active Communication	Refers to the process of exchanging information between agile team members (i.e. senders and receivers) formally and informally, which should be efficient and effective.	Alzoubi & Gill 2015
Agile Software Development (ASD)	A software development method is said to be an agile software development method when a method is mainly people focused and communication-oriented, flexible (ready to adapt to expected or unexpected change at any time), speedy (encourages rapid and iterative development of the product in small releases), lean (focuses on shortening timeframe and cost and on improved quality), responsive (reacts appropriately to expected and unexpected changes), and learning (focuses on improvement during and after product development).	Qumer & Henderson-Sellers 2006b, p. 125
Agility	A persistent behaviour or ability of a sensitive entity that exhibits flexibility to accommodate expected or unexpected changes rapidly, follows the shortest time span, uses economical, simple and quality instruments in a dynamic environment and applies updated prior knowledge and experience to learn from the internal and external environment.	Qumer & Handerson-Sellers 2006b, p. 281
Agile Enterprise Architecture (EA)	A blueprint that describes the overall structural, behavioural, social, technological, and facility elements of an enterprise's operating environment that share common goals and principles with the ability of responsiveness (scans, senses and reacts appropriately to expected and unexpected changes), flexibility (adapts to expected or unexpected change at any time), speediness (accommodates expected or unexpected changes rapidly), leanness (focuses on	Gill 2013a,

	reducing waste and cost without compromising on quality), and learning (focuses on enterprise fitness, improvement and innovation).	
Communication	A process in which participants create and share information with one another in order to reach a mutual understanding.	Rogers 1986, p. 199
Communication Challenges	Refer to the characteristics of each medium that decrease communication efficiency and effectiveness.	Clark & Brennan 1991
Communication Effectiveness	Delivering a message to the receiver who understands it as it was intended with minimal disruption and misunderstanding, even if it takes a long time.	Alzoubi & Gill 2016
Communication Efficiency	Delivering a message to a receiver with high quality and with minimal time, cost, effort, and resources required to establish communication.	Alzoubi & Gill 2016
Enterprise Architecture	The organising logic for business processes and IT infrastructure, reflecting the integration and standardisation requirements of the company's operating model.	Ross et al. 2006, P.9
Formal Communication	Refers to explicit and clear communication such as the agile requirements backlog, plans, and card walls.	Herbsleb & Mockus 2003
Informal Communication	Refers to the communication that happens outside the official reporting hierarchy of the team.	Herbsleb & Mockus 2003
Software Development (SD)	The tasks undertaken to construct a [software-based product], and the management of this effort, by a group of stakeholders with agendas, who engage in transactions over time within an institutional context by applying structure to their work with a set of tools and methodologies, and who judge outcomes of their efforts and act accordingly.	Sambamurthy & Kirsch 2000, p. 400
Software Functionality	The extent to which the delivered software system meets its functional goals, user needs, and technical requirements.	Lee & Xia 2010

Software Quality	Represents the assessment of the quality of the task performed by the individual, or the pair, on the programming task. It is reflective of how well the code satisfied the requirements stipulated in the problem statement and produced correct results.	Balijepally et al. 2009, p. 102
Software Performance	Refers to four dimensions; on-time completion (meets its baseline goals for duration), on-budget completion (meets its baseline goals for cost), functionality (meets its functional scope goals), and quality (a good working product).	Alzoubi & Gill 2016

Abstract

Agile development is a highly collaborative environment, which requires active communication among stakeholders. This active communication helps in producing high quality working software systems in short releases and iterations. Due to the ever-increasing competition, there is an increasing interest among practitioners and researchers in contemporary geographically distributed agile development (GDAD). GDAD claims to offer several benefits over co-located agile development such as lower production cost, around the clock development, faster time to market, and the liberty of involving the most talented developers across the globe. However, in the GDAD environment, active communication is difficult to achieve due to many challenges such as differences in geographical locations and time.

Literature has reported that agile enterprise architecture (EA) could help enhancing GDAD communication and performance. However, little empirical evidence is known to support this claim. Furthermore, it is not clear how to effectively achieve and study active communication construct in GDAD in terms of its dimensions, determinants and effects on performance? As a result, there is a lack of understanding about how GDAD organisations can establish and maintain active communication among distributed teams. This dissertation contributes to this research gap, first, by developing a research model based on an extensive systematic literature review on the GDAD communication challenges, techniques and strategies to mitigate these challenges, and the impact of communication on GDAD software performance. This study provides important insights about GDAD communication by identifying and empirically examining the relationships among the two dimensions of active communication (communication efficiency and communication effectiveness), one antecedent that can be controlled (agile enterprise architecture (EA)), and four aspects of GDAD performance (on-time completion, on-budget completion, software functionality, and software quality).

The study then validates the research model using an integrated research approach that combines quantitative and qualitative data analyses. The quantitative data are collected using a survey technique from 160 responses and analysed using Partial Least Squares

(PLS) analyses. The qualitative data are collected using interview techniques through 10 post hoc case studies and analysed using content analysis technique.

This study reports that agile EA has positive impacts on communication efficiency and communication effectiveness, and on GDAD performance. It has also been found that communication efficiency and communication effectiveness have significant differential impacts on GDAD performance aspects. While communication efficiency is, generally, related to on-time and on-budget completions, communication effectiveness is, generally, related to functionality and quality aspects.

While the prior GDAD literature offers little guidance for GDAD communication issue, this research contributes to both theory and practice, and offers a number of useful insights and agile EA driven GDAD model. From theory perspective, insights and model are theoretically based on and empirically tested about the value and positive impact of agile EA on active communication dimensions and GDAD performance, and the impact of communication efficiency and communication effectiveness on GDAD performance in the GDAD environment. Moreover, from practice perspective, this study indicates that agile EA, communication efficiency, and communication effectiveness together increase the GDAD performance and thus, facilitate a better GDAD performance than in GDAD that does not employ agile EA.

Despite the above-mentioned contributions, like any other studies, this study has also some limitations such as sample size, time and potential analysis bias of applied qualitative and quantitative research methods. A number of steps were taken to mitigate or minimise the effects of these limitations. Thus, findings of this work should be considered with its limitaiotns when interpreting it in the relevant theoretical and practical context.