DEVELOPMENT OF AN AUTOMATED SERVICE LEVEL AGREEMENT NEGOTIATION FRAMEWORK FOR SAAS CLOUD E-MARKETPLACE

NNAJI, UCHE JOSIAH
(21PCG02289)
B.Sc. Computer Science, Crawford University, Ota, Ogun State

AUGUST, 2023

DEVELOPMENT OF AN AUTOMATED SERVICE LEVEL AGREEMENT NEGOTIATION FRAMEWORK FOR SAAS CLOUD E-MARKET PLACE

BY

NNAJI, UCHE JOSIAH
(21PCG02289)
B.Sc. Computer Science, Crawford University, Ota, Ogun State

A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE (M.Sc.) DEGREE IN COMPUTER SCIENCE IN THE DEPARTMENT OF COMPUTER AND INFORMATION SCIENCES, COLLEGE OF SCIENCE AND TECHNOLOGY COVENANT UNIVERSITY, OTA, OGUN STATE, NIGERIA

AUGUST, 2023

ACCEPTANCE

This is to attest that this dissertation is accepted in partial fulfilment of the requirements for the award of the degree of Master of Science in Computer Science in the Department of Computer and Information Sciences, College of Science and Technology, Covenant University, Ota, Nigeria.

Miss Adefunke F. Oyinloye
(Secretary, School of Postgraduate Studies) **Signature and Date**

Prof. Akan B. Williams
(Dean, School of Postgraduate Studies) **Signature and Date**

CERTIFICATION

We certify that this dissertation titled "**DEVELOPMENT OF AN AUTOMATED SERVICE LEVEL AGREEMENT NEGOTIATION FRAMEWORK FOR SAAS CLOUD E-MARKETPLACE**." is an original research work carried out by NNAJI, UCHE JOSIAH (21PCG02289) in the Department of Computer and Information Sciences, College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria under the supervision of Azubuike Ezenwoke, Ph.D. We have examined and found this work acceptable as part of the requirements for the award of Master of Science (M.Sc.) in Computer Science.

Dr. Azubuike A. Ezenwoke
(Supervisor) **Signature and Date**

Prof. Olufunke O. Oladipupo
(Head of Department) **Signature and Date**

Prof. Adebukola S. Onashoga
(External Examiner) **Signature and Date**

Prof. Akan B. Williams
(Dean, School of Postgraduate Studies) **Signature and Date**

DECLARATION

I**, NNAJI, UCHE JOSIAH (21PCG02289),** declare that this research was carried out by me under the supervision of Azubuike Ezenwoke, Ph.D. of the Department of Computer and Information Sciences, College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria. I attest that the dissertation has not been presented either wholly or partially for the award of any degree elsewhere. All sources of data and scholarly information used in this dissertation are duly acknowledged.

NNAJI, UCHE JOSIAH

Signature and Date

DEDICATION

With boundless gratitude, I dedicate this work to the Almighty God for His limitless wisdom, grace, unmerited favour, and unwavering love, guiding every step of my journey.

ACKNOWLEDGEMENTS

I express my heartfelt gratitude to God Almighty for His mercy and strength, which empowered me to conduct this research study efficiently and effectively. Special thanks go to my parents and siblings for their unwavering love and support.

I am deeply indebted to my supervisor, Azubuike Ezenwoke, Ph.D, for his profound mentorship, unwavering dedication, and invaluable guidance, which played a significant role in the success of this research study. His patience and understanding have made a lasting impact on me. Thank you so much, sir. May God Almighty continue to bless and protect you.

I would like to recognize the leadership and sponsorship of the Covenant Applied Informatics- Africa Centre for Excellence (CApIC-ACE) for granting me the chance to pursue my studies at a prestigious institution like Covenant university. I extend my appreciation and regards to Prof. Adetiba who has contributed to my research growth and development.

I am grateful to my dear friends Favour Folorunsho, Jumoke Adeyemi, Paul Jesusanmi, Damilola Adeniji, Adegoke Faith and Opeyemi Odetola for their unwavering support and encouragement during challenging times. Your presence has been a source of strength, and I celebrate each one of you.

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ACL	Agent Communication Language
ANP	Analytic Network Process
ASV	Aggregated Satisfaction Value
CCSN	Cloud Computing Service Negotiation
CLI	Command-Line Interface
CNA	Consumer Negotiator Agent
CP	Counterproposal
CSPs	Cloud Service Providers
DSR	Design Science Research
DSS	Decision Support System
ER	Evaluation Results
GUI	Graphic User Interface
IAAS	Infrastructure-as-a-Service
JADE	Java Agent Development Environment
JVM	Java Virtual Machine
MAS	Multi-Agent Systems
MAUT	Multi-attribute Utility Theory
NIST	National Institute of Standards and Technology
PAAS	Platform-as-a-Service
PNA	Provider Negotiator Agent
QOS	Quality of Service
SAAS	Software-as-a-Service
SLA	Service Level Agreement
TOPSIS	Technique for order preference by similarity to ideal solution
VMs	Virtual Machine

ABSTRACT

With the rising number of Software-as-a-Service (SaaS) users, meeting their diverse needs while maintaining Quality of Service (QoS) has become crucial. SaaS providers continually offer new applications with different offerings and QoS parameters, but individual user QoS requirements can be overlooked in the current Cloud e-marketplace. To address this, Service Level Agreement (SLA) negotiations are used for cloud service selection and to guarantee SaaS user satisfaction, often facilitated by brokers. These brokers ensure optimal offers from providers, considering the user's preferences. Brokers ensure that before an agreement is initialized, cloud providers are ranked, and negotiation occurs only if the user does not accept the offer of the best provider. Selecting the most suitable provider and negotiating these QoS parameters can be a complex task for brokers given the high number of users and providers. This paper aims to present a negotiation framework that increases the customer satisfaction value of SaaS users using a service broker. The proposed framework leverages multi-agent systems (MAS) as the methodology for our proposed negotiation framework. By adopting this proposed negotiation framework, SaaS users can get services from providers that can meet their specific requirements. The experimental results obtained during the simulation show that the proposed framework performs better in terms of the level of satisfaction, response time, and success rate of negotiation compared to previous studies.

Keywords: ***Multi-agent system, SaaS, Cloud e-marketplace, Service ranking, SLA negotiation.***