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A Model for On-Premises ERP System and Cloud ERP Integration

Ms. Amizhthini Nakkeeran, Ms. Mahikala Niranga, Dr. Ruwan Wickramarachchi

Department of Industrial Management

University of Kelaniya

Sri Lanka

amizhkeeran@gmail.com, nirangam@kln.ac.lk, ruwan@kln.ac.lk

Abstract

Market demand changes have led to the emergence of cloud ERP solutions that have become the growing trend nowadays as that they bring new processing capabilities without making significant changes in the existing system. But it alone does not provide businesses with all necessary and best functionalities as different businesses have different requirements. So, integrating multiple best-of-breed applications with cloud to build or fortify a near-custom ERP will automate processes and increase revenue for the business. A survey done by AMR research with 639 companies on integration requirements of SaaS customers shows that 70% of the companies expect to integrate their on-premises legacy applications to the SaaS solution. Also, states that application integration strategy will play the key role in post-modern ERP market. Though integration has been around for over a decade and there are many integration approaches between the two systems, they result in a brittle environment and a progressively more complex architecture as new integrations are added over time. This study analyses whether technological integration, business integration and socio-organizational integration affect the successful integration and aims to develop a model based on the findings for successful integration.

Keywords

SaaS-Software as a Service, ERP, on-premises system, Integration, post-modern ERP

1. Introduction

1.1. Research Background

So far implementing an ERP (Enterprise Resource Planning) system was seen as a strategic capital investment. The demand for better IT solutions for a business keeps changing as it grows. As the market demand changes there will be a change in enterprise solution. This evolution led to the emergence post-modern ERP era. “Post-modern ERP is a situation where companies abandon the traditional practice of using single, monolithic ERP platforms for several unique tasks and instead adopt a collection of individual standalone programs” (www.gartner.com). It’s described as a “loosely coupled decentralization” of traditional ERP suite systems by experts. In recent years, large enterprises have been benefiting from transitioning some of their application portfolios to computing clouds and integrating their applications due to the fact that they bring new processing capabilities without making significant changes in the existing system. Cloud ERP uses SaaS (Software as a Service) Concept. Though the complete transition from a conventional system to a cloud system is successful, business wise, it’s a hard decision to make. Also, complete transition from on-premises system to Cloud services does not provide businesses with all necessary functionalities as the necessities of different businesses differ. So, integrating multiple best-of-breed applications with cloud to build or fortify a near-custom ERP will automate processes and increase revenue for the business. Also, businesses will be able to select what they actually need instead of going for a whole package. This integration concept breaks the idea that you should have one product for all operations and that a business should get all of its enterprise gear from the

same vendor, which is a drawback of traditional ERP. This reduces the additional overheads to the businesses. Gartner, a leading technology research and advisory firm, had projected nearly 100 % fail rate for cloud ERP projects by 2018. “Ninety per cent of those rolling out what the mega-analyst has defined as “post-modern ERP” will succumb to the traditional ERP headaches of higher costs, greater complexity and failed integration by 2018. Their Achilles Heel will be lack of an application integration strategy and related skills”, it stated. So, a successful integration and integration strategy plays a major role in the successful implementation of ERP in the post-modern ERP era.

There are several challenges faced in the integration other than technical though integration has become technically possible over a decade now. The challenges include business decisions, capability, change management in the organization, keeping up the vendor and customer relationships as a business and etc. “Fundamentally, a couple of technical challenges have to be mastered. However, more challenges emerge in non-technical areas like service market fluctuation, organizational issues, and questions of economics” as Michael Kleeberg states in his paper on “Information Systems Integration in the Cloud: Scenarios, Challenges and Technology Trends”. Since the integration has become technically feasible, businesses stop focusing on the other factors that affect the integration as mentioned above. This has led to practical troubles after implementation and eventually lead to the failure of integration. Considering available time and resource constrains, this research will be limited to focus on the factors affecting integration of on-premise system to cloud to form a cloud ERP solution and the study will focus on implementing a model for successful integration.

1.2. Problem Identification

Though the concept of integration of several best of breed applications have been heard widely in recent times, there are very few successful integrations we could come across in practical stations. Also, in Sri Lankan context, it's still a fresh practice and not much of the organizations has implemented it in major scale nor ready to implement integration in recent times due to the fact that their success rate is still undefined. In global context, there are several challenges faced in integration of systems.

Most of the literatures that speak about integration has been published after 2007 (Tobon Velencia.Estefania, The Integration of ERP and Inter-intra organizational information systems). According to the studies on ERP and IS implantation, a framework has been proposed by Kähkönen (2017) to study integration as three types: technical Integration, Business Integration and Socio- Organizational Integration. The author defines technical integration as “the ability to make applications or systems to exchange data”. When referring to business integration, the author clarifies that it is needed when a business process is automated, as different sources of information are integrated to complete the process. Finally, socio-organizational integration concerns the interactions between stakeholders from different organizational units. Change Management is studied under this perspective. As much literatures are not available on the topic of on-premises system integration to cloud ERP and the framework for successful integration is not spoken much, taking Kähkönen’s framework mentioned above into consideration, the factors affecting on-premises system integration to cloud ERP are to be identified and categorized to see whether this framework fits for the integration and aims to propose a model for successful integration. This has led to the formation of the research problem, “whether technical Integration, Business Integration and Socio- Organizational Integration affect the success of integration of on-premises system to cloud ERP?”

Research Questions

This research is to address the problem “whether technical Integration, Business Integration and Socio- Organizational Integration affect the success of integration of on-premises system to cloud ERP?”

For the ease of study, the research problem is divided into two main research questions concerning the focus of the research problem statement. Since the main research questions are too broad to answer, the two main research questions are further divided into sub research questions for the ease of conducting the research. Key Research Questions and sub questions:

RQ1: What are the factors under physical, business and socio-organizational integration that affect the integration?

SQ1.1 – What are the other factors that do not fall into these three types of integrations but affect the integration?

- RQ2: How the integration of on-premises system to cloud ERP could be carried out successfully?
 SQ2.1 – How all the factors identified can be altered to carry out successful integration?
 SQ2.2 – What are the best practices that can be followed in the integration process to avoid failures?

1.3. Research Objectives

Considering the research questions, following research objectives were designed with the aim of answering the research questions that are already raised.

- RO1: To identify the critical factors for the successful the integration of on-premises systems to cloud ERP.
- RO2: To identify the way of utilizing each factor for successful integration
- RO3: To identify the best practices that can be followed in the integration process to avoid failures
- RO4: to form a framework/model for successful integration of on-premises systems to cloud ERP.

Table 1. Research objectives formulation

Key Research Question	Sub Questions	Research Objectives
1. What are the factors under physical, business and socio-organizational integration that affect the integration?	1.1 What are the other factors that do not fall into these three types of integrations but affect the integration?	1. To identify the critical factors for the successful the integration of on-premises systems to cloud ERP.
2. How the integration of on-premises system to cloud ERP could be carried out successfully?	2.1 How all the factors identified can be altered to carry out successful integration?	2. To identify the way of utilizing each factor for successful integration
	2.2 What are the best practices that can be followed in the integration process to avoid failures?	3. To identify the way of utilizing each factor for successful integration. 4. To identify the best practices that can be followed in the integration process to avoid failures

The methodology used to conduct the research is presented in section 2. Section 3 presents the critical analysis of the findings with the purpose of answering the research questions and with regards to the research objectives. Section 4 proposes the framework towards designing model for successful integration of on-premises system to cloud ERP. Finally, the research paper provides the discussion and conclusion with providing directions to future research areas.

2. Methodology

This study is conducted in order to address the knowledge gap in the integration of on-premises systems to Cloud ERP, followed by factors affecting the integration of on-premises and cloud ERP systems. A structured literature review is performed referring the stages used by Sara E et al, (2019): identifying the relevant literature, structuring the review and developing a model to guide future research. Both qualitative and quantitative research methods to be used here. Interviews will be conducted as a qualitative approach to collect data and thematic study would be used to

analyze the data collected. The facts from the literatures and interviews will be validated using questionnaires which is a quantitative approach. The data from questionnaire will be analyzed using statistical software to come up with a final model for integration of on-premises system to cloud ERP. The methodology of the research is explained further in figure 1.

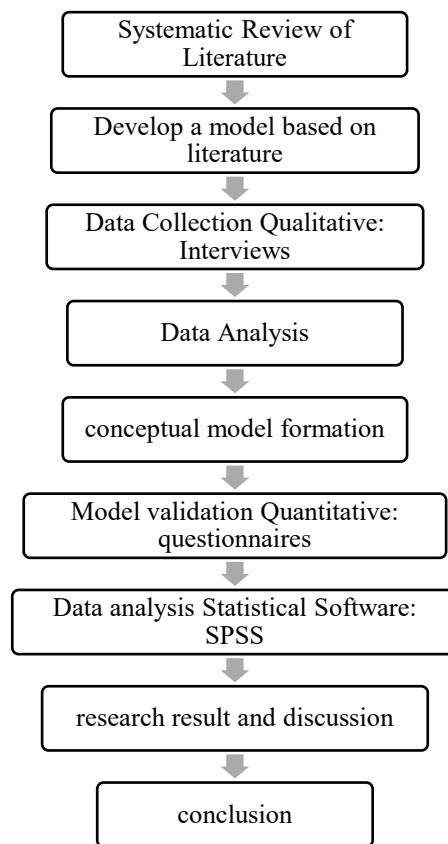


Figure 1. Methodology used for the research

With the basic study of existing knowledge materials as well as considering the research scope and time constraints, the research process is designed.

2.1 Identification of Relevant Literature

The relevant literature was identified through a systematic process to select articles from four different online databases (Google Scholar, Emerald, Science Direct and Research Gateway). The Initial search was applied for the publications in the areas of ERP integration, on-premises ERPs, On-premises systems, cloud integration and cloud ERP which were published in the period of year 1990 to 2019 with relevant key words selected by the authors. Referred key words: “on-premises system”, “integration”, “ERP”, “enterprise resource planning”, “cloud”, “factors”, “post-modern ERP”, “success” and “implantation”. In total 92 publications were found. This initial selection process only considered the title, abstract and the keywords of the article.

Initially selected publications followed another two phases of screening in order to identify the most relevant and valid literature for the research area. In the screening phase 1 total selected articles were undergone a careful reading of the title, abstract and the key words to evaluate the suitability and the relevance of the publication. In this Stage, articles that did not consider integration were disregarded. Screening phase 1 concluded with remaining 65 publications which were then moved to the screening phase 2.

The screening phase 2 was strictly focused on filtering the most relevant content for the current research topic. Remaining 65 publications were fully evaluated by the topic, research problem, methodology used, data collection tools and analysis as well as the findings or the proposed models/ frameworks of the publication. Each article was evaluated twice to ensure the strict screening process and concluded selecting total 40 publications for further analysis of the research.

2.2 Structuring the Review

The selected 40 publications were carefully studied under areas of ERP integration, cloud integration and on-premises to cloud integration and then taken into a summery table under the most important sections: Research domain, published year, title, author/authors, methodology, findings, and important facts (if any). This summery table was later used for the conceptual designing of framework and data analysis stages.

2.3 Development of The Conceptual Framework

After the screening phase 2 the selected articles were carefully analyzed with the intention of the development of the proposed conceptual framework of the research. Among selected 40 final publications 27 articles involved in the development of the conceptual framework and the remaining 13 articles provided further knowledge regarding the subject area and used for the discussion and review purpose. The developed conceptual framework provides clear understanding and provide guidelines for further researches.

3. Analysis

Identified most relevant literature in 40 publications were carefully analyzed for the purpose of structuring the review and the development of the conceptual framework for further research purpose. The areas as on-premises ERP, cloud computing and cloud ERP and integration were covered in the analysis.

3.1 On-premises ERP

ERP is a software system aims to integrate all functional units of the enterprise in a cooperative way. It may also extend to include parties outside the enterprise for example supplier and customer to involve them in the integration (Ali M,2017). The traditional or conventional ERP is of two types: on-premises ERP and hosted ERP (22). In on-premises system, the software is licensed based. It might be licensed for use on a particular computer or by number of users. The license can either be on a term basis or perpetual and the software is located in-house. It's often treated as a capital expense. In the case of hosted ERPs, the licensed applications are hosted by a third party. This is deployed as a separate instance on a hardware dedicated to the organization or a separate virtual instance dedicated to an organization. Sometimes it's deployed using a private cloud where the instance of ERP is hosted by a third party and delivered to the end user on subscription basis. This may or may not be deployed via internet.

The advantages of on-premise ERP systems are highly customizability and they offer greater control over data. Longer implementation time and high cost of owning the licensed software and associated hardware and IT tools are the downsides of on-premises are the disadvantages of the on-premises ERPs. Therefore, now with the change of trend, organizations find that cloud ERP systems are more comfortable and suitable to the business.

ERP has been evolving for generations starting from a material requirement planning application to and enterprise resource planning software that includes several modules that involve all the business key functionalities and make them easier. On-Premises Software is the traditional method of implementation where you buy the software license and install the software on your in-house hardware. Your internal IT staff maintains the software and handles upgrades. In some cases, you can outsource support of the software to a third-party IT service provider even though the software is installed on your hardware (Arnesen, Spencer,2019).

3.2 Cloud computing and cloud ERP

Cloud computing is a promising trend where the applications, hardware and software is delivered as a service via internet. Capability to deliver variety of IT services, on demand is the fundamental characteristic of cloud computing (Rajkumar Buyya,2013). "The cloud computing services are offered in 3 forms: Infrastructure-as-a-Service (IaaS),

Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS). IaaS offer infrastructure on demand in the form of virtual hardware, storage and networking. Platform-as-a-Service solutions deliver scalable and elastic runtime environments on demand and host the execution of applications which are backed by a core middleware platform that is responsible for creating the abstract environment where applications are deployed and executed “(Rajkumar Buyya,2013). Software-as-a-Service solutions provide applications and services on demand. Windows Azure, Facebook, sales force are some examples of SaaS. These applications are shared across multiple users over internet whose interaction is isolated from the other users.

There are many ERP solutions offered in the market as cloud ERP solutions. Cloud ERP solutions are provided via the Software as a Service model of cloud computing. It is accessible via internet browser without installing or configuring the system at the user side. The advantages of cloud ERP are scalability, reliability, availability, mobility, accessibility and usability and low cost compared to implementation of on-premises systems. The down sides are, it’s less customizable and may have data security and integrity concerns.

There are plenty of researches done analyzing the cloud concept and the types, through it is comparatively new. This shows the dominance of the cloud technology. The Mastering Cloud Computing book (2013) states three major models for deploying and accessing cloud computing environments. They are public clouds, the most common deployment models in which necessary IT infrastructure is established by a third-party service provider that makes it available to any consumer on a subscription basis; private/enterprise clouds, the cloud infrastructure is operated solely for a business or organization, and serves customers within the business fire-wall and hybrid cloud, a composition of private Cloud and public Cloud that the private Cloud. Cloud ERP solutions are delivered via the Software as a Service model. It is important to note that some ERP solutions that are marketed as ‘cloud based’ are in fact hosted ERP solutions (Scavo et al. 2012). These systems are typically accessed by a common browser over an Internet connection, allowing access that has little dependency on client configuration. Examples in this relatively new category include sales force software, SAP Business by Design, which was coded separately from its existing on-premise system. The factors affecting adoption of ERP as SaaS are cost, security, availability, usability, implementation, ubiquity, flexibility, comparability, analytics and best practices according to Björn Johanssona, Pedro Ruivob (2013). As stated in the literature on Exploring factors affecting service quality of ERP on cloud: a revelatory case study, the advantages of cloud ERP are: less risk, no upfront cost, controlled, secure, ubiquitous access, streamlined operations, automatic and cost-free scalability (Sumedha Chauhan,2015) which make it highly preferable.

3.3 Integration and factors affecting integration of on-premises system to cloud ERP

There are enough researches on on-premises ERP adoption and conversion to cloud- based ERP (Björn Johanssona, 2013). But a very few available in the integration perspective. Shi Jai in his research on “Integrating conventional ERP system with cloud services: from the perspective of cloud service type” (2009), states that the integration has become a trend as it brings new processing capabilities without introducing significant changes to existing system. Also, he states that this integration related studies mostly focuses on SaaS (Software as a Service). In this study the respective implications of integrating ERP with three types of cloud services: SaaS, PaaS and IaaS are analyzed and he also states that the integration at SaaS level is for achieving immediate business value and productivity enhancement. At PaaS level the objective of integration is to enhance software development life cycle management. And the main integrating intent at IaaS level is to enable scalability and reliability of hardware resources without changing existing IT infrastructure (Shi Jai,2009).

Björn Johanssona, (2013) has taken 10 factors that affect cloud ERP adoption into consideration. They are costs, security, availability, usability, implementation, ubiquity, flexibility, compatibility, analytics and best-practices in the ranking order. But the research by Björn Johanssona does not consider integration as an important part of adoption and concludes that these factors play least role when it comes to integration of on-premises system with cloud ERP as it needs more and variable functional and non-functional requirements.

The research by Wei Sun (2007) states “though SaaS is delivered over Internet and charged on per-use basis, it is software application in essence. SaaS contains business data and logics which are usually required to integrate with other applications deployed by a SaaS subscriber. This makes Integration become one of the common requirements

in most SaaS adoptions”. Here the integration requirements are considered and the factors influencing the integration are analyzed only bases on SaaS model of cloud computing.

When considering the factors affecting the integration, though many literatures are not specifically discussing about on-premises and cloud ERP integration, those found can be generalized to this scenario depending on the relevance. A literature on Supply chain integration through community cloud: Effects on operational performance states that the factors affecting integration are physical and informational flow integration, flexibility and deliveries (S Bruque-Cámara,2016). Shi Jia in his research discusses that lack of customization opportunities is one of the downfalls of the on-premise and cloud ERP integration (2009). A case study-based research on Application Integration: Enterprise Resource Planning (ERP) systems in the hospitality industry states that the factors affecting the integration are flexibility and adaptability (Paula Serdeira Azevedo,2014). In the literature on BI and ERP integration, it’s stated that technical innovation, reliability and availability, scale efficiency, and system flexibility are the main concerns of integration (DC Chou,2005).

Pei-Fang Hsu states that the ERP and E-business integration are affected by factors as business process coordination, cost efficiency, differentiation and intangible benefits (PF Hsu,2013). In Information Systems Integration in the Cloud: Scenarios, Challenges and Technology Trends by Michael Kleeberg, it’s stated that the market fluctuations, organizational issues and questions of economics affect integration in addition to technical challenges (M Kleeberg,2014). A research by Rajiv Malhotra, states that the project team structure, implementation strategy, database conversion strategy, risk and change management strategies have impact on integration (R Malhotra,2010). Development of Modular Integration Framework between PLM and ERP Systems by B. N. Prashantha states, “There are various approaches that a company can take to accomplish integration between PLM and ERP. Each approach will provide differing levels and complexity of integration, functionality, scope, and cost of implementation and support. Companies need to assess the issues described previously and select the best approach based on their specific needs, future plans, current infrastructure, and estimated cost.” (BN Prashanth,2017). “The new generation of integration solutions features single robust integration platforms designed to deliver everything needed for cloud and on-premise application integration. The ideal integration platform provides complete deployment flexibility, integration capabilities, connectivity, and reusability” (Dan Moore,2011). The integration of ERP and inter-intra organizational information systems: A Literature Review states that the types of integration are categorized as technical integration, business integration and socio-organizational integration (TV Estefania.2018). The technical innovation, reliability and availability, scale efficiency, and system flexibility are the main concerns of integration (David C. Chou 2005).” The new generation of integration solutions features single robust integration platforms designed to deliver everything needed for cloud and on-premise application integration. The ideal integration platform provides complete deployment flexibility, integration capabilities, connectivity, and reusability” (D Moor,2011).

4. Discussion

Based on the literatures, most of the researches on integration are done after 2007 and some are specifically discussing about module to module integration, integration on the basis of cloud architecture and no much articles are discussing about the generalized integration of on-premises system to cloud ERP. Though not all ERP integrations are not similar, most can be generalized to our case. The factors such as system flexibility, compatibility, informational integration, business flexibility, innovations, cost, user satisfaction, interaction among vendors and change management are discussed repeatedly in literatures which can be categorized into three types of integration as mentioned in earlier technical Integration, Business Integration and Socio- Organizational Integration.

Referring to the most relevant selected literatures, this research identified four main variables that impacts on integration of on-premises system to cloud ERP. The identified variables: technical Integration, Business Integration and Socio- Organizational Integration and performance of integrated system. After the analysis a conceptual framework has been designed for further studies. The proposed conceptual framework is shown in Figure 3

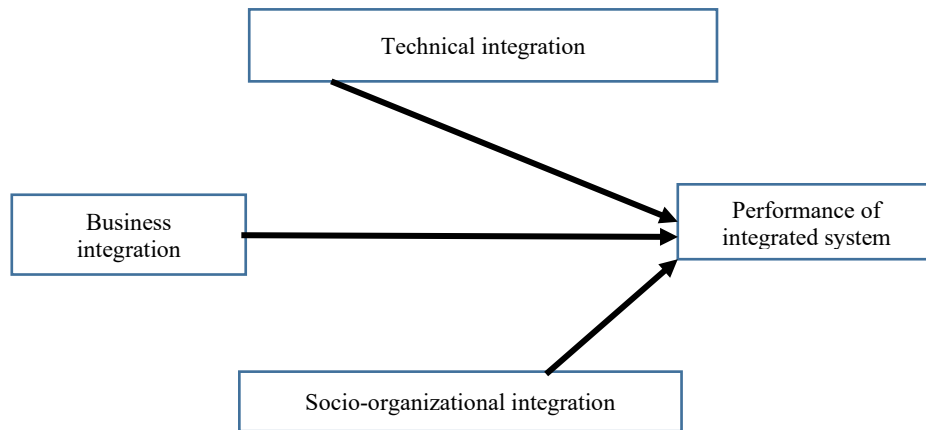


Figure 3. Proposed Conceptual Framework

The proposed conceptual framework can be further elaborated with the indicators for each variable. Structured literature review was used to identify all the factors/indicators. In future researches these indicators can be further explained. A summarized table of elaboration on each variable is further explained in Table 2.

Table 2. Indicators for the conceptual framework variables

Variable	Indicators
Technical integration	Physical integration (system flexibility & compatibility)
	Informational integration
	Technological innovation
	Integration capabilities
Business integration	Business Flexibility and support
	business process coordination
	User satisfaction
	Project team structure
	Implementation strategy

	Business strategy
	project team structure
	Cost efficiency
Socio-organizational integration	risk management strategies
	Change management
	market fluctuations
	questions of economics
	Interaction among vendors
Performance of integrated system	Productivity/value maximization
	Reliability
	adaptability

Current research work contributes to fill the knowledge gap between integration and integration of on-premises system and cloud ERP. The idea of system and cloud integration will be beneficial to many companies and also help in the area of sustainability. This research will be further conducted in future to evaluate each relationship and quantify the impact and also to analyze how the changes in the ERP market would impact the current trend of integration. The findings of the research will be valid for the context of integration from on-premises system and cloud ERP and also can be generalized to any integration processes to cloud.

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Biographies

Ms. Amizhthini Nakkeeram is a final year undergraduate from University of Kelaniya, Sri Lanka, majoring in Business Systems Engineering and following BSc in Management and Information Technology degree offered by Department of Industrial Management, Faculty of Science.

Dr. Ruwan Wickramarachchi He is a Senior lecturer at the Department of Industrial Management, University of Kelaniya. He holds BSc in Industrial Management from the University of Kelaniya and MPhil in Management studies (specialised in Information systems) from the University of Cambridge, United Kingdom. He received his PhD in distributed simulation from the Sheffield Hallam University, United Kingdom. His specialized areas include Management Information Systems, Electronic Commerce and Operations Management. His main research interest is in the field of applications and distributed simulation. He has published many researches including,

- Saad S. M., T. Perera and R. Wickramarachchi, 2002, " A new methodology for parallel and distributed Simulation & quot, Proceedings of the 2002 International Conference on Responsive Manufacturing
- Saad S. M., T. Perera and R. Wickramarachchi, 2002, " A strategy selection approach in parallel and distributed simulation environment & quot; International Journal of Advance Manufacturing Systems. Vol 6, No.2

Ms. W. A. M. Niranga obtained Bachelor of Business Administration (Honors) degree in Human Resource Management from the University of Peradeniya in February, 2013. Later, she started her career as an academic and achieved experience for more than five and a half years where she received the academic excellence from research and teaching. Apart from that, she was awarded a gold medal for her continuous research excellence by the University of Sri Jayawardhanapura in 2018, recognizing one of her research papers as the most outstanding. She joined the Department of Industrial Management, University of Kelaniya as a lecturer in April, 2019.

She attained her Master of Business Administration and Masters in Labour Relations and Human Resource Management from the University of Colombo in 2018. She is also a visiting lecturer to many other reputed institutions in Sri Lanka.