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Minimum Viable Product in Information Systems Development Context: Systematic Mapping Study

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Full research paper

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Abstract

Minimum Viable Product (MVP), initially introduced for start-ups, permits organisations to test the market demand for a product without investing a substantial number of resources. Due to this nature of minimising the risks and costs in the product development, not only start-ups in the information system development (ISD) context but also established organisations have started to adapt MVP in product development processes. Therefore, it is critical to understand how the notions of MVP can be employed in the ISD context. This study aims to identify common characteristics of MVP in the ISD context to support ISD organisations to define a better MVP for their product development processes. A systematic mapping study was performed by defining research questions, conducting a literature search, and defining selection criteria. Finally, the study presents the most used MVP characteristics in the ISD context and suggests a better combination of characteristics together with MVP's original definition.

Keywords Minimum viable product, Minimum viability, Information system development

1 Introduction

There is ample evidence to suggest that the notion of the minimum viable product (MVP) brings substantial benefits to product and services development (Duc and Abrahamsson 2016; Reis 2011). Many scholars regard MVP being the new conventional wisdom for entrepreneurs (Anderson et al. 2017) as well as established organisations (Dennehy et al. 2019). Due to the MVP's ardent focus on minimising resource allocations, result orientation, and testing outcomes in uncertain and ambiguous markets, not only start-ups but also established organisations have commenced adopting its principles (Schmitt 2021). Especially, the concepts of MVP can be most useful for information system development (ISD) in their products and services (henceforth products) development processes (Munteanu and Dragos 2021). The traditional focus of ISD organisations has been on the technical and managerial aspects with an emphasis on developer and project manager perspectives (Nuwangi et al. 2012; Sedera et al. 2014). Nevertheless, because of the often associated with innovative sophisticated technology, the vibrant global community of intrapreneurs and entrepreneurs, and continuously increasing expectations of the customer base (Lokuge et al. 2018), ISD organisations tend to consider the customer perceived value of their products (Lokuge et al. 2020; Münch et al. 2013). Using MVP, ISD organisations able to run the process of experimentation and learning which allows empirical discovery of customer perceived value through a systematic cycle of testing value propositions rapidly with real customers to eliminate waste in the ISD process (Anderson et al. 2017).

The MVP concept is first proposed by Frank Robinson in 2001 and later redefined by Eric Reis in his book based on the lean start-up method in 2011 (Lenarduzzi and Taibi 2016). Eric Reis (2011) defined MVP as a version of a new product, which allows a team to collect the maximum amount of validated learning about customers with the least effort. Starting from this definition, the definition of MVP has evolved and various definitions have been given to MVP by different organisations (Lenarduzzi and Taibi 2016). MVP of one product can be different from another product. However, identifying common characteristics of MVP is critical to define a better and fail proof MVP for the future ISD projects.

Previous studies on MVP in the ISD context are limited and the majority of the studies focus only on ISD start-ups (Dennehy et al. 2019). Among the previous studies, the systematic mapping presented to identify key factors for building MVP by Lenarduzzi and Taibi (2016) and the analytical framework presented by Nguyen-Duc (2020) to capture context factors for developing an MVP are significantly contributing to filling the void in the literature in defining the MVP, hardly any of them have dealt with defining an MVP in ISD practice. This study considers ISD organisations. The notions of MVP do not discriminate whether the ISD organisation is a start-up or an established organisation (Dennehy et al. 2019). In all circumstances and contexts of ISD, MVP is equally applicable to all ISD organisations (Dennehy et al. 2019). Despite this popularity of MVP amongst ISD organisations, previous literature on this area is surprisingly sparse. To address this research gap, this study focuses on the systematic mapping of existing literature on theoretical and practical efforts to create an MVP in ISD organisations, intending to answer the research question "In information system development organisations, what are the common characteristics of MVP compared to the original definition of MVP?"

The remainder of this paper is structured as follows, section two presents the background of the lean start-up methodology, MVP, and systematic mapping technique. Section three explains the research methodology used including formulating research questions and a systematic mapping protocol. Section four includes the systematic mapping results and the discussion. The final section describes the conclusion and future work.

2 Background

This section briefly explains the underlying concepts of MVP, the lean start-up methodology, the build measure learn cycle, and the relationship of these concepts to MVP. In addition to that, the systematic mapping method is explained in this section.

2.1 Lean Start-up Methodology

Lean Start-up Methodology is a method of managing and building a business by developing products iteratively by experimenting based on results from real tests and incorporating user feedback (Anderson et al. 2017; Reis 2011). This ground-breaking methodology presented by Reis (2011), explains how to simplify the product development process by stepwise development and reduce risks, costs, and wasteful development processes by the idea of business hypothesis testing. The five core principles of lean start-up methodology are as follows, 1) Entrepreneurs are everywhere, 2) Entrepreneurship is management, 3) Validated Learning, 4) Build-Measure-Learn and 5) Innovation accounting (Reis 2011).

The first principle explains the opportunities available for entrepreneurs and the second principle explains the type of management required for handling the extreme uncertainty in start-ups (Frederiksen and Brem 2017). Validated learning explains capturing knowledge from conducting experiments with potential customers to test a business hypothesis (Frederiksen and Brem 2017). Build-Measure-Learn is the step where ideas are transformed into products (Lenarduzzi and Taibi 2016). This is an iterative process that continues in a loop and one of the main concepts in this study, MVP is created during this Build-Measure-Learn cycle to collect the maximum amount of validated learning about customers with the least effort (Reis 2011). The final principle, innovation accounting explains the measurement of the progress of the start-up to precisely validate the formed business hypothesis (Frederiksen and Brem 2017). Figure 1 displays the relationship between MVP and Lean start-up methodology.

Figure 1: MVP in Lean start-up methodology

2.2 Systematic Mapping

A systematic mapping study is a technique that provides a structure of the type of published research studies and their results by categorizing them (Petersen et al. 2008). This technique presents a visual summary of the results in nature of a map. The systematic mapping presented in this study is inspired by the study on MVP definition by Lenarduzzi and Taibi(2016). This process involves defining research questions, conducting a search by finalizing keywords and identifying all literature sources, selection criteria and exclusion criteria definition, data extraction, and mapping process, and finally obtaining study results. Figure 2 presents the systematic mapping design inspired by Petersen et al. (2008).

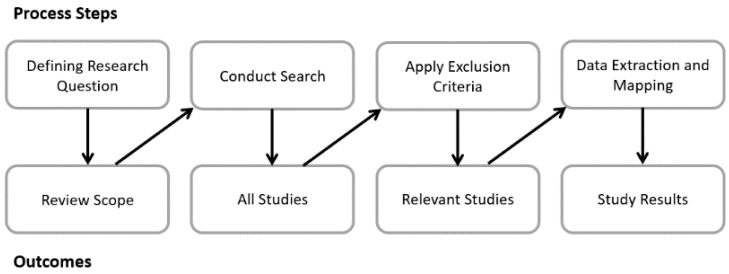

Figure 2: Systematic Mapping Design

3 Methodology

This section presents the definition of the research question, protocols followed to conduct the research including literature source identification and finalizing keywords, and definition of selection criteria and exclusion criteria.

3.1 Research Question Definition

As the first step of the systematic mapping process, the research question is formulated using the protocol of the PICO framework PICO stands for Population, Intervention, Comparison, and Outcome (Lenarduzzi and Taibi 2016). The PICO framework applied to the above-mentioned research question is as follows, “In information system development organisations (P), what are the common characteristics (I) of MVP(O) compared to the original definition of MVP (C)?”. This research question is further refined as below,

RQ1.1: What are the common characteristics of MVP in the current ISD context?

RQ1.2: Are the characteristics of MVP in the current ISD context, different from the original characteristics?

3.2 Conducting the Literature Search

As the second step of the systematic mapping, a literature search is conducted by identifying reliable literature sources and identifying keywords for the search.

3.2.1 Literature Sources Identification

A combined search process of the automatic and manual search was used for this literature search. The research studies are chosen using a keyword inter-disciplinary literature search in EBSCOhost, the online database of published research articles in business, science, engineering, and IT disciplines. To ensure the reliability of the data, only articles published by reputable publishing houses were considered for review. All the journals reviewed were peer-reviewed, which ensures the quality of the content in those journals.

3.2.2 Keywords Identification

Since the PICO framework is followed for the definition of research questions, keyword identification is supported by the same framework. Table 1 presents the identified keywords to conduct the search.

Criteria	Terms
P – ISD organisations	"Start-up", "Established", "Outsourcing"
I – MVP Characteristics	"Minimum Viable Product"

Table 1:Keywords Identification

As there is a limited number of studies found on MVP and applying the terms identified in the population narrows down the results than the minimum required result set for this study, keyword combinations are omitted, and the only keyword used for the literature search is "Minimum Viable Product".

3.3 Defining the Selection Criteria

The selection criteria include three steps that are general exclusion criteria, title and abstract screening, and full paper screening. The relevant papers are identified through a manual keyword search in the selected database. After identifying the papers from the general exclusion criteria, the paper screening is applied to further refine the papers and identify the most relevant papers. In the application of general selection criteria, the papers that are published in academic journals in the English language are included. Only the full papers were included and the papers that are not in peer reviewed journals are excluded. In selection through title and abstract screening, the papers that are in the non-tech background and the review papers are excluded. In full paper screening selection criteria, the papers are studied to make sure that they satisfy the research question. The papers that do not include MVP characteristics were excluded by applying this search criterion.

4 Study Results

A total of 461 studies were identified through the keyword search and after applying the general exclusion criteria, 70 papers remained. After checking for duplicate papers, 20 papers were removed from the results. Title and abstract screening further eliminated 6 unqualified papers. Finally, after the application of full paper screening total of 23 papers including 9 papers from the business discipline and 14 from science, engineering, and IT disciplines remained in the search results.

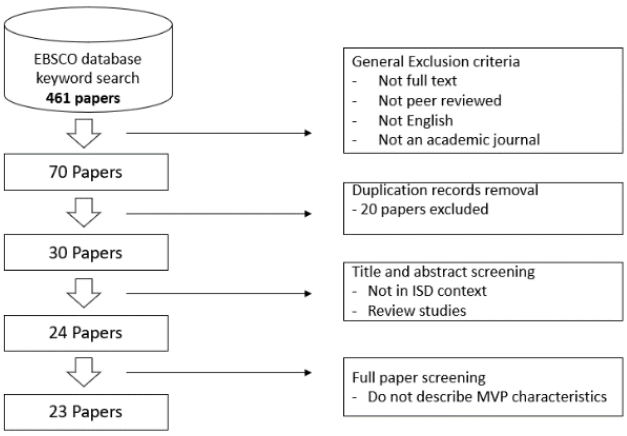

Figure 1: Exclusion criteria and screening

4.1 Overview

The selected papers remained after applying the full search criteria is 23 papers. The papers are published between the period of 2015 to 2022. And these papers which meet the study criteria present a conceptual or developed MVP in an information system development context and describe the characteristics of the developed MVP. All the studies present different MVPs with different functionalities. These studies were conducted in the United States, Romania, Germany, Austria, Switzerland, Brazil, Netherlands, Iraq, Australia, Greece, and the UK. There are 17 studies about start-up and new product development from the scratch, 5 established organisations, and one outsourcing scenario where a website was developed as MVP for the online magazine delivery.

4.2 Extracted Characteristics of MVP

Table 1 illustrates different characteristics of MVPs presented by selected papers. Full text screening was done to identify and extract the characteristics of the presented MVP. Since writing is subjective, similar terms were extracted from the studies and given a common term to represent the idea.

MVP characteristics extracted from full text screening	Common term
Least effort (Fernandes et al. 2017; Humphreys 2015) Less time and effort (Schmitt 2021) Smaller effort (Som de Cerff et al. 2018) Minimum effort (Perez-Vidal et al. 2019)	Least effort
Incremental and iterative development process (Alazzam et al. 2021; Biroscak et al. 2018; Cleland-Huang 2015; Duerden et al. 2016; Haddad et al. 2020; Munteanu and Dragos 2021; Oliveira et al. 2015; Perez-Vidal et al. 2019; Wang et al. 2022) Pivot appropriately (Boni and Abremski 2022; Humphreys 2015; Thickstun 2021) Update according to feedback and provided back to future users for another round of testing (Hill et al. 2021) Stage wise development (Sun et al. 2021) Develop-measure-learn cycles (Savvidis et al. 2018)	Incremental and iterative development
Initial customer requirements (Perez-Vidal et al. 2019) Potential early customer feedback (Armstrong 2016; Biroscak et al. 2018; Duerden et al. 2016) Immediate user feedback (Humphreys 2015) Early customers (Som de Cerff et al. 2018)	Target early adopters
Validate hypothesis (Armstrong 2016; Döderlein 2018; Perez-Vidal et al. 2019; Schmitt 2021) proving and/or disproving hypotheses (Boni and Abremski 2022) Validate the assumptions (Biroscak et al. 2018) Testing a hypothesis (Alazzam et al. 2021; Choi-Fitzpatrick and Hoople 2019; Cleland-Huang 2015; Duerden et al. 2016; Eras et al. 2022; Fernandes et al. 2017; Greenfield 2017; Hill et al. 2021; Humphreys 2015; Oliveira et al. 2015; Som de Cerff et al. 2018; Sun et al. 2021; Wang et al. 2022) Testing a product idea (Savvidis et al. 2018; Thickstun 2021)	Testing a hypothesis
Avoid wasting time and resources for unwanted products (Duerden et al. 2016; Greenfield 2017; Humphreys 2015) Launching a product with more chance of success (Cleland-Huang 2015; Fernandes et al. 2017; Perez-Vidal et al. 2019) Lowest risk (Cleland-Huang 2015)	Reduce Wasteful Product/Process
Release rapidly as possible (Duerden et al. 2016) Frequent releases (Munteanu and Dragos 2021) Rapidly (Biroscak et al. 2018)	Frequent Deliveries
Focused on the essential features (Perez-Vidal et al. 2019) Essential functionality to support business (Cleland-Huang 2015) Core business/ functions (Döderlein 2018; Sun et al. 2021) Explanation on focusing on the main target (Boni and Abremski 2022; Eras et al. 2022; Haddad et al. 2020; Hill et al. 2021; Oliveira et al. 2015; Wang et al. 2022)	Focus on core problem
Learning from customer feedback (Duerden et al. 2016; Hill et al. 2021; Sun et al. 2021)	Validated learning

Feedback loops with customers (Cleland-Huang 2015; Humphreys 2015; Munteanu and Dragos 2021; Savvidis et al. 2018)	
Validate a market entry point (Boni and Abremski 2022)	
Measure and assess what customers tell (Thickstun 2021)	
Validated learning (Armstrong 2016; Biroscak et al. 2018; Duerden et al. 2016; Eras et al. 2022; Fernandes et al. 2017; Oliveira et al. 2015; Perez-Vidal et al. 2019; Schmitt 2021; Som de Cerff et al. 2018; Wang et al. 2022)	
Future user/ potential customer needs (Alazzam et al. 2021; Hill et al. 2021)	Target existing customer needs
Satisfies consumers' needs (Munteanu and Dragos 2021)	
Real users (Greenfield 2017; Thickstun 2021)	
Actual customer needs (Haddad et al. 2020; Oliveira et al. 2015; Savvidis et al. 2018; Schmitt 2021; Sun et al. 2021)	
Real value to the customers (Cleland-Huang 2015)	
Existing customer feedback (Duerden et al. 2016)	
Just enough features/ structure to work (Fernandes et al. 2017; Thickstun 2021)	Focus on basic functionalities
Basic functionalities (Alazzam et al. 2021)	
Minimum required features (Armstrong 2016; Hill et al. 2021; Oliveira et al. 2015; Perez-Vidal et al. 2019)	
Minimum marketable features (Cleland-Huang 2015)	
Sketch on napkin/wireframes (Humphreys 2015)	
Start with basic functionalities and improving (Boni and Abremski 2022; Haddad et al. 2020; Sun et al. 2021)	

Table 2. Common Term Identification

As the result of the above-mentioned categorization, ten common terms that represent the MVP characteristics were identified in Table 2 displays. These common terms were used for the mapping of the identified studies. Table 3 displays the mapping results including the presented MVP and their highlighted characteristics. The identified common characteristics from the studies are explained below.

The least effort explains that the MVP is developed with a minimum level of effort that can be invested in the product development (Schuh et al. 2018). Incremental and iterative development explains the development style of MVP is stepwise which means the product developers preferred doing the product improvements from increment to increment in different development iterations (Munteanu and Dragos 2021). Target early adopters, early adopters are the first customers who will attract to the product (Duc and Abrahamsson 2016). Therefore, targeting feedback of the early adopters is crucial to making the product decisions for the next iteration (Adikari et al. 2021; Dennehy et al. 2019). Testing a business hypothesis characteristic depicts the development of a fundamental business hypothesis and tests it with feedback received from the visionary early adopters (Anderson et al. 2017; Rosemann et al. 2000). Reduce Wasteful Products/Processes is about reducing and eliminating wasteful processes and unwanted features or product developments (Anderson et al. 2017). This provides the opportunity to reduce waste by allowing producers to decide whether continue or abandon the product based on the received customer feedback. Frequent deliveries describe the MVP's nature of releasing product versions with slight changes frequently to the customers to collect real user feedback (Anderson et al. 2017; Atapattu and Sedera 2012). Focus on the core problem explains focusing on the main functionality of the product and eliminating secondary functionalities (Schuh et al. 2018; Sedera 2006). Validated learning is about collecting the maximum amount of feedback from the customers (Lenarduzzi and Taibi 2016; Sedera and Lokuge 2017). Target existing customer needs term explains targeting the needs of existing customers of the product (Dennehy et al. 2019). This applies to both ISD established organisations and outsourcing organisations. Focus on basic functionalities is about developing a product with just enough functionalities instead of developing sleek advanced functionalities and collecting the maximum amount of validated learning from customers (Nuwangi et al. 2018; Schuh et al. 2018).

4.3 Identified Common Characteristics of MVP

From the results of table 3, the most common characteristics mentioned in the studies can be identified and the following research question can be answered.

RQ1.1: What are the common characteristics of MVP in the current ISD context?

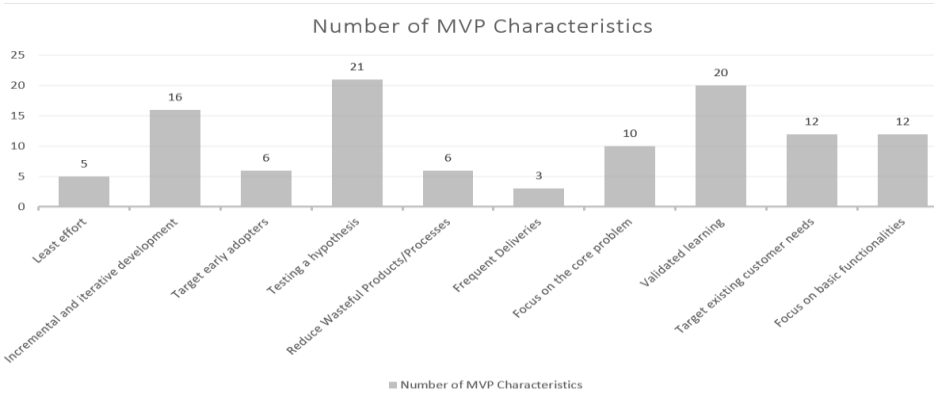

Figure 2:MVP Characteristics Summary

Figure 4 displays the summary of the mapping results including MVP characteristics identified and the number of times they were mentioned in the selected studies. Frequent deliveries can be identified as the least common characteristic among current MVP definitions. The least effort, target early adopters, reduce wasteful products or processes, and focus on core problem characteristics are moderately repeating among the MVP definitions. Therefore, these can be identified as common characteristics. Majority of the studies mentioned testing a business hypothesis as a characteristic of MVP. In table3, only two studies did not specifically mention this characteristic in their study. However, the MVP they developed was based on testing a business hypothesis. In addition to that, incremental and iterative development style, validated learning, target existing customer needs, and focus on basic functionalities are the most common MVP characteristics that are repeated in the study sample.

RQ1.2: Are the characteristics of MVP in the ISD context, different from the original characteristics?

This study considers the definition presented by Reis (2011) as the original definition of MVP and compares the characteristics mentioned in the original definition with the study results. The characteristics in the original definition are, 1) Least effort, 2) Validated learning, 3) Target early adopters and 4) Testing a hypothesis (Reis 2011). The study results show that all these characteristics are still use in current ISD practice. The focus on least effort has reduced over time, however still it is rarely used as an MVP characteristic in the ISD context. Validated learning, targeting early adopters, and testing a hypothesis are still commonly used to define the MVP despite the evolution of MVP definitions. In addition to the characteristics in the original definition, incremental and iterative development style, reducing wasteful product/process, frequent deliveries, focusing on the core problem, targeting existing customer needs, and focusing on basic functionalities are identified as the new additions to consider when defining MVP in ISD context.

5 Conclusion and Future Work

This study presents a systematic mapping of MVP characteristics to identify common MVP characteristics in the current ISD context. For the systematic mapping, 23 reliable studies on MVP development in the ISD context are used and, 10 characteristics of MVP are identified. Each characteristic identified from MVP's original definition presented by Reis (2011), was mentioned in at least 5 studies out of 23. Testing a business hypothesis and validated learning were the most repeating characteristics among the selected studies.

This study provided a summary of MVP studies and how it relates to the context of ISD – to maintain its competitive advantage. A deeper understanding of MVP allows an ISD organisation to focus on the cost in its developing of ISD solutions, while maintaining a perspective of product innovation. The study also identified sub-constructs of MVP to understand its nature of application in the ISD context. According to the study results, the most used MVP characteristic is 'testing a hypothesis.' This is attributed to the importance of early check of feasibility of an idea which is considered critical to the ISD organisations (Biroscak et al. 2018). This study also identified the least commonly applicable characteristic of MVP - the least effort. This contradicts the popular belief that ISD organisations are mainly focused on 'cost effectiveness' of the products (Döderlein 2018; Sedera and Lokuge 2019). Such findings make an important knowledge contribution to the current ISD context. For future work, the study suggests applying the findings of MVP in ISD outsourcing in a field study to derive empirical results. This work is currently underway.

Study	MVP	ISD type	MVP Characteristics									
			Least effort	Incremental and iterative dev. style	Target early adopters	Testing a hypothesis	Reduce wasteful processes	Frequent deliveries	Focus on core problem	Validated learning	Target existing customer needs	Include only basic functionalities
(Boni and Abremski 2022)	Digital health tool	Start-up		×		×			×	×		×
(Munteanu and Dragos 2021)	Banking software	Established		×				×		×	×	
(Schmitt 2021)	Website	Established	×			×				×	×	
(Perez-Vidal et al. 2019)	Robotic polishing tool	Start-up	×	×	×	×	×		×	×		×
(Döderlein 2018)	mobile payment platform	Established				×			×			
(Biroscak et al. 2018)	Human Centered Design tool	Start-up		×	×	×		×		×		
(Fernandes et al. 2017)	Decision support model	Start-up	×			×	×			×		×
(Cleland-Huang 2015)	Website	Outsource		×		×	×		×	×	×	×
(Humphreys 2015)	Mobile Application	Start-up	×	×	×	×	×			×		×
(Som de Cerff et al. 2018)	Meteorological IT project	Start-up	×		×	×				×		
(Duerden et al. 2016)	Custom evaluation tool	Established		×	×	×	×	×		×	×	

(Wang et al. 2022)	Datamining prediction model	Start-up	×		×			×	×			
(Eras et al. 2022)	Bluetooth doorbell	Start-up			×			×	×			
(Alazzam et al. 2021)	Mobile Application	Start-up	×		×				×	×	×	
(Greenfield 2017)	Smart city	Start-up	×		×	×			×	×		
(Thickstun 2021)	Online music lesson	Established	×		×				×	×	×	
(Hill et al. 2021)	Telehealth system	Start-up	×		×			×	×	×	×	
(Choi-Fitzpatrick and Hoople 2019)	Pro-social drone	Start-up			×							
(Oliveira et al. 2015)	Intelligent middleware	Start-up	×		×			×	×	×	×	
(Armstrong 2016)	Landing Page	Start-up		×	×				×		×	
(Savvidis et al. 2018)	Video Game	Start-up	×		×				×	×		
(Haddad et al. 2020)	Digital tool	Start-up	×					×		×	×	
(Sun et al. 2021)	Mobile Application	Start-up	×		×			×	×	×	×	

Table 3: Mapping Results

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