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PROCESS MODEL FOR SYSTEMATIC REQUIREMENTS PRIORITISATION PROCESS IN AN AGILE SOFTWARE DEVELOPMENT ENVIRONMENT BASED ON 5S APPROACH: EMPIRICAL STUDY

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ABSTRACT

In an unstable software development characterized by the turbulence of markets and the competitive pressures, the organization is forced to adopt new software development methodology to be survival. The agile methods have been introduced to maintain the organization endurance. New challenges await agile methods, when requirement prioritisation and re-prioritisation happened frequently, this leads to unstable and disorganize requirement prioritisation process in agile development environment. To improve its effectiveness and make the environment more systematic and organized, this study proposes an adoption of the lean manufacturing tool, which is 5S approach. The 5S approach improve the work environment as it's designed to check the process and guaranty that issues are identified and get rid of issues. Consequently, this study aims to identify the issues that affect the requirement prioritisation process. Therefore, in-depth interviews have been carried by involving 18 agile practitioners from different agile software development companies. The data collected for this study were analyzed by using grounded theory techniques (Open, Axial and Selective coding). The results are proposed a process model that will allow an improvement of the process by applying a suitable "S" to overcome the issues that might lead to unsystematic and disorganize environment.

Keywords: *Agile methods, Requirements Prioritisation process, Lean manufacture, 5S approach, Requirements analysis*

1. INTRODUCTION

At present, the software development nature has been changed, is considered as a backbone for most products and major success factor determining whether a product succeeds. Therefore, it becomes more important to be flexible in handling changing requirements to meet current customer needs and to deliver fast to the market. As a solution agile methods have started to be adopted by industry [1].

Agile methods have been proposed in 1990s with the aim to minimize process bureaucracy by avoiding unnecessary milestones due to extensive documentation. The methods are intended to deliver software system quickly to users, who can then propose new and changed business requirements into the system. The philosophy behind agile methods is reflected in the agile manifesto [2],which are individuals and interactions, working software, customer collaboration and responding to change. Some examples of agile methods are Extreme Programming, Scrum, Crystal, Adaptive Software Development, Dynamic System Development Method and Feature Driven Development.

One principle of the agile methods is incremental delivery where the software is developed in releases with the user specifying the requirements in each release. In order to determine which increment should be developed first, some kind of requirements prioritisation process has to be performed by a set of selected stakeholders [3-5]. On the other hand, being agile means being able to "deliver quickly, change quickly and change often" [6]. It is envisaged that when changes happen frequently and rapidly, requirements become more volatile and unstable[7]. This causes the prioritisation process environment to be

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unsystematic and problematic [7-9] . Moreover, the process affects the people involved tremendously. To cope with the changes, stakeholders experience chaotic and stressful moments. They feel insecure and thus, they are prone to making mistakes. Such an environment is unhealthy as it affects not only the quality of the end product but as also the well-being of individuals (dynamic re-prioritisation) [7, 9]. One solution to the problem is to organize the agile development environment.

In many workplaces, disorder problems arise owing to the large number of people working and the countless of hours engaged in costly non-value added activities. These problems adversely affects business administrative work surroundings and they may escalate into bigger problems including long lead times, low productivity, high operating costs, late deliveries, unreasonable ergonomics, space limitations, frequent equipment breakdown and hidden safety hazards [10]. Therefore, a process proven for decades in Japanese manufacturing industry offers a practical solution. The process is known as 5S. It is primarily method that proposes a complete quality environment [11] by arranging the workplace through the use of five Japanese words; seiri (sort), seiton (set in order), seiso (shine), seiketsu (standardize) and lastly, shituske (sustain). The 5S was first planned to enhance the manufacturing systems [12], and to boost the creation and maintenance of an orderly, tidy, successful and large quality workplace. The adoption of the 5S method is effective at producing effectual workplace business and enhancing the function's ability and safety [13-15]

The aspects of requirements prioritisation process environment has been identified [7]. The issues that affect this environment should be known in order to adopt 5S approach. Thus, this paper is suggesting the process model in which the proper stakeholders can be identified based on their characteristics in the agile development environment based on 5S approach which ensures to overcome arising issues.

The paper consists of six sections. It begins with an introduction followed by the related works on the requirement prioritisation process and lean manufacturing. Then it is followed by a brief explanation of the research methodology and how it was used. After that, it presents the empirical results of the study. In addition, it shows and discusses the proposed process model. Lastly, the paper concludes the main findings and offers suggestions for future research.

2. RELATED WORK

2.1 Agile Requirement Prioritisation Process

Agile development relies on the interaction with the customer and gathers requirements throughout the development process [16]. However, the informal nature of agile requirements engineering practices may be considered unacceptable [17]. Developing software systems rapidly to cope with the incoming changes however imposes some challenges. When several requirements change simultaneously and fast, they become volatile and disorganized [8]. This causes the prioritisation process that determines which requirements to be developed becomes problematic. This phenomenon is complicated particularly when it involves multiple stakeholders [18]. The stakeholders have to reach consensus under hectic and often disoriented situations. This leads to an unhealthy and unsafe workplace, which affects not only the quality of the software systems but also the well-being of individuals [19-20].

Agile requirements prioritisation is a continuous process that is initiated at the beginning of iteration, it indicates the requirements dynamics [21]. Requirements prioritisation and selection processes basically focus on the people rather than one particular customer [22]. Hence, at the initial stage of the iteration, requirements have to be collected and prioritized [23]. This assists in identifying the top features in the project. Generally speaking, a top requirement is scheduled to be implemented in the next iteration, or it is kept on indefinite hold [24].

Among the agile manifesto's core values is that individuals and interactions over processes and tools, and this reveals the emphasis of agile methods on teams, working software, customer collaboration and change response [2]. Due to the possibility of prioritizing requirements based on different aspects, different roles are called for in the agile prioritisation process to obtain correct information [25]. So, during the requirements prioritisation process, a number of stakeholders determine which requirement should be implemented as they are releases [21-22, 26], and for this, skillful people is required [27]. Hence, it is important that a highly-skilled team is present to adopt frequent iterations [6]. According to this notion, interpersonal skills and characteristics are important for the entire team members [28].
In other words, professional skills are required to be successful in employing agile methods as

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emphasized by Stankovic et al. (2013), Solinski and Petersen (2016). Agile methods call for high qualifications of developers without which ineffective developments will be the outcome (delays in iteration development [9, 29]. Team members should hold the right qualifications as well as their leaders in order to be effective otherwise it may lead to poorly conducted meetings, lack of prioritisation knowledge and other adverse outcomes that may influence the environments [9, 30-33].

Added to the above, the customer that belongs to the organization that is paying for software development is chosen as a representative of the entire stakeholders on the project. The customer should then be equipped with characteristics like being a domain expert and being able to decide on product acceptance and requirements prioritisation [24]. The development team also has to fully comprehend the requirements and the changes forwarded by the customers and this necessitates effective communication skills. When a team developer does not possess the right social skill, it will be difficult for stakeholders to obtain information on the specific module progress, and in turn this leads to the inability to provide accurate requirements for iteration [28]. Furthermore, this maximizes the development cost as the module will eventually require reworking, and as the reliance on developer's social skills increases, the instability will increase [28].

It is thus acknowledged that the requirements prioritisation is the phase that needs the agreement of people in terms of the selection and priority of suitable requirements. This is when the human characteristics are brought to the process by the people during their interactions and such characteristics can be categorized into knowledge [8, 24, 34-35], Authority [24, 26-27, 36], Experience [27, 36], communication skills [35] and availability [24, 35]. The selection of participants with suitable intellectual characteristics and attitudes is important to bring about the process of agile requirements prioritisation for accurate prioritisation of requirements.

More importantly, customers are human and because of this, they contribute specific values and preferences to a project. They come from different backgrounds reflecting their knowledge specializations and interests. Hence, a customer representative of the project should hold the authority to reach decisions concerning prioritizing requirements [27]. The customer has to be available to capable of answering questions of the development team, delay in the answers can lead to delays in the product development [24, 37]. This lays an emphasis on importance of the client's ability to answer the entire questions being a domain expert and someone who is knowledgeable on the application workings and the input/output data needed [24, 27, 38]. Added to the above, face-to-face communication and obtaining direct feedback are among the agile practices and in relation to this, the client has to have good communication skills and he has to be able to effectively relay ideas to the members of the development team [39].

According to Dyba and Dingsoyr (2008), the characteristics of agile methods include short iterations with small releases and rapid feedback, close participation of users, frequent communication and coordination and collective ownership, knowledge and capability to develop and use knowledge among the members of the development team. This highlights the characteristics that are needed by the development team [27, 32].

More specifically, the members of the development team has to be capable of communicating in different ways through email, telephone, among other media, and they have to be goal-oriented [2, 40]. The development team members also have to be experienced to succeed in building the system [40-41]. and they have to possess business and technical knowledge to be able to constantly interact with the customers [35, 42-43]. Contrastingly, inexperienced members of the development team could lead to difficulty in discussing complex tasks owing to their lack of experience or knowledge [44]. This is supported by other studies that related the importance of self-organizing teams [33, 45], an aspect that has been overlooked by requirements engineering studies. In relation to this, a self-organizing team appropriates the workload among the members and contributes to making decisions [46]. Aside from this, the development team availability is important in implementing some functionality or in applying specific information for tasks completion -in case he or she had to complete tasks for other projects- thereby this might affect a phase that affects all agile development phases [44, 47].
In addition, the people on the project possessing suitable characteristics can use almost any process and accomplish their tasks. However, even with

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these characteristics if executive or top management support is lacking, the project could fail [33, 38]. In this, insufficient support can prevent even experienced members in achieving a successful project [38]. This is mapped with principle number five in the agile manifesto, which is; "build projects around motivated individuals and top management give them the environment and support their need, and trust them to get the job done" [2]. As well as, the extreme requirements prioritisation is a core practice in agile software development [39]. This is largely dependent on timely decision from the team members. A delay in scheduling meeting with important person owing to refusal from the members to take on responsibility for decision making can negatively affect the agile team [48]. It is thus important for top management to authorize the working agile team [49]. Top management should also solve issues to facilitate project progress decisions, particularly in dynamic project surroundings, and in sum, lack of top management availability could lead to risks [38, 50].

Moreover, the management of agile software development team calls for project manager, product owner or leader that possesses effective communication and coordination skills and creativity in ensuring maximum attention span of team members in meetings [41]. Leaders make use of effective leadership styles according to specific circumstances and this may also influence the outcomes of the project [33, 40]. Dynamic surroundings call for constant attention and care like the modifications or removal of requirements that could be prioritized later – this highlights the product owners' or project manager availability and responsibility to answer questions that may emerge [7, 51].

According to Cockburn and Highsmith (2001) and Tessem (2014), the project leader has to hold the decision power and authority to bring about innovation and to react to the dynamic environment. The leader or project manager should be competent in building and managing agile software development team [40]. Additionally, an experienced agile project manager makes use of his experience to drive the team in achieving the required tasks [52]. and he promotes knowledge sharing among the team members for sustainable development [40]. A project manager having sufficient technical and business knowledge is one that is experienced enough to explain them to clients and to develop their confidence in the team [42].

The important of requirements prioritisation setup in agile software development environment lead to expected result as customer needs. It seems the difficult to be organized the environment because it depends on many people since the customer is considered a key person in this process. Therefore, the suitable roles and characteristics individual should be known to achieve the activities as required to make the environment more systematic and organize. To reach a renewal of dynamism, this paper recommend to adopt one of Lean Manufacturing tools which is 5S approach that offers promising perspective in this environment.

2.2 Lean Manufacturing

Lean manufacturing was proposed by the Japanese automotive industry, Toyota production system, and it has been successfully applied in both manufacturing and service fields [53]. Competitiveness in dynamic developing market conditions can be ensured through the implementation of lean manufacturing for organizations [54]. It is recognized as an extensive set of much effective techniques for waste identification and its elimination from processes in order to enhance system and reduce on the whole production costs [54]. Lean manufacturing techniques is generally adopted for their low cost and to reduce costs, increase quality and improve the delivery time of services [55]. Lean eliminates waste and concentrates on value-added activities from the customers' point of view [53, 56-57].

Throughout the years, several lean tools and concepts have been forwarded and daily ones are proposed to assist the employment of their principles and to eliminate waste in companies [58]. For instance, Melton (2005) proposed five key lean tools; particularly for process industries and they are kanban, 5S, visual control, Poke Yoke and Single minute exchange of SMEDs while 36 lean tools for the machine tool industry were proposed by Eswaramoorthi and Kathiresan (2011). In Pavnaskar et al.'s (2003) study, they highlighted 101 lean manufacturing tools and seven-level classification scheme for their categorization. It is evident that several researchers provided a discussion of commonly implemented lean manufacturing tools [58-61].

Visual Control: In manufacturing plants, visual indictors, displays and controls are employed to enhance effective relaying of information like

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customer requirements, production schedules, and the management's aims and objectives across enterprises [62-63].

Value stream mapping: This is an analysis method that enables the definition of primary productivity reserve of a production unit by following the overall production flow [64] .

Total productive maintenance (TPM): The TPM refers to an initiative that optimizes the reliability and effectiveness of manufacturing equipment [62, 65] and it enhances the equipment's overall efficiency through a complete productive maintenance system for the equipment's life cycle with the contribution of employees from top management to subordinates through encouragement and participation [66].

5S Approach: In many workplaces, disorder problems arise owing to the large number of people working and the countless of hours engaged in costly non-value added activities. These problems adversely affects business administrative work surroundings and they may escalate into bigger problems including long lead times, low productivity, high operating costs, late deliveries, unreasonable ergonomics, space limitations, frequent equipment breakdown and hidden safety hazards [10].

It is clear from the above overview of tools that lean manufacturing tools should be selected according to implementation requirements of the prioritisation process in agile software development environment and it should not add to the non-value adding activities. Suitable lean manufacturing tools have to be chosen to discard wastes and enhance the performance metrics of the process in the environment. The selection should be limited to tools that have the most overall impact on the identification of wastes, performance metrics or organizing the environment based on the requirements prioritisation process. Consequently, using the suitable tools at the right time within the limited resources for the right circumstances is very crucial. Hence, the need to establish a match between lean manufacturing tool and requirements prioritisation process wastes exists. Therefore, 5S is an efficient technique that may enhance housework, environmental functionality, in addition to safety criteria methodically [67]. In other words, this research opted for the 5S approach because it is a basic tool favoring an environment of effective work, creating a dynamics of change, reducing waste and moving the company into the change approach [64].

2.2.1 5S Approach

The 5S practice throughout the years among Japanese firms is aimed at enhancing human capability and productivity. Ever since its inception by Takashi Osada in the 1980s, it is believed to lead to increased environmental performance in the production line in the field of housekeeping, health, safety and others [68]. Understanding 5S is widespread in Japan as it originates from a premise that considers life wisdom that is daily practiced [69]. Also, good housekeeping is believed to get rid of safety problems, boost morale, and increase both efficiency and effectiveness [70].

5S is considered to be one of the components of lean manufacturing and its implementation is deemed to be the basic steps for successful manufacturing [71]. The 5S concept was brought forward by Hiroyuki Hirano [72] and it stresses on neatness, cleanliness, simplification and safety adherence across the organizational sections for optimum work performance [71].

Moreover, the 5S refers to a total quality environment methodology [11] that organizes based on the five Japanese words of seiri (sort), seiton (set in order), seiso (shine), seiketsu (standardize) and shituske (sustain). The method was initially brought forward to develop production systems [73]. This method boosts the creation and maintenance of a workplace's organization, cleanliness, effectiveness and high quality. In other words, the adoption of 5S is mainly aimed at generating effectual organized workplace and improving work quality and safety [74-76].

In order to ensure that the 5S practice leads to value-added methods, the proponents of 5S provided a stepwise approach towards achieving total quality environment [77]. The next paragraphs explain the meaning of 5S phases as presented in Figure1.

Seiri (sort): Seiri or sort is the first phase and it involves the differentiation between what is wanted and what is unwanted, what is significant and what is insignificant, and the clients both internal and external. In other words, this phase entails the determination of the importance of everything in the workplace [78]. All the things are gone through to differentiate between what is significant and

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what is trivial and to remove the unwanted tools, components and directions. The entire resources, supplies in the plant and workshop is reviewed, the essential things kept and the useless ones discarded. This involves the prioritisation of matters based on their necessity, and their maintenance in readily-available locations – in sum, everything is kept or discarded [15].

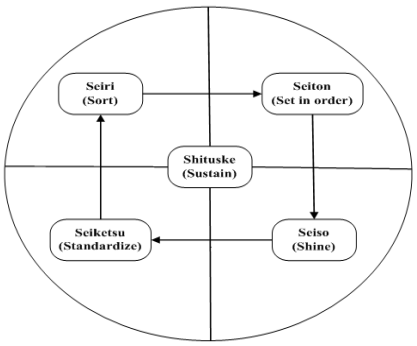

Figure1: 5S approach

Seiton (Set in order): In this phase, everything is placed on its own location for a more effective workspace [78]. Things that are not often used should be left outside of immediate workspace [15]. based on the premise that everything that is needed should be readily accessible [79].

Seiso (Shine): in this phase, after arranging the workplace and everything is coordinated for effective use [79]. the focus turns to cleaning the working environment [80] and this encapsulates the confirmation of account and review of everything for clean up and to address any issue [78].

Seiketsu (Standardize): This phase calls for working through teams to execute the new operation in conventional functioning [78] . Everyone should be updated of their obligations in terms of the first initial phases [79].

Shituske (Sustain): This phase is the most difficult phase to carry out and achieve [78-80]. It is crucial to remain vigilant so as not to revert back to the old ways of achieving things [80]. As a consequence, following the 5S way in the workplace should be done so with discipline [78-79]. The corporation's culture plays a key role in how this phase is achieved [81].

3. METHODOLOGY

This study identifies the issues that influence the selection of people during the prioritisation process in an agile development. The identified issues could help decision maker work in requirement prioritisation process to select the appropriate person based on their characteristics to be on this environment. Therefore, this study used empirical interview with practitioners from the software industry.

The study aimed to answer the following research questions. The questions were derived based on a preliminary study of the subject matter.

1. What are the issues that may face the people regarding their characteristics in agile software development, especially in requirements prioritisation process?

2. How can 5S contribute in formulating a process model by identifying the critical characteristics that require overcoming of issues for performing systematic requirements prioritisation process in agile software development environment?

In order to identify the issues, interviews with several domain experts and practitioners from the industry were conducted. The face-to-face interviews with experts sought to collect information on the specific subject matter [82]. The approach was selected because it is well suited to a research that requires an understanding of deeply rooted, delicate phenomenon, responses to complex systems, processes or experiences. The in-depth interviews offer the opportunity for clarification and detailed understanding [83].

The interviews used semi-structured questions, which were constructed based on the RP process. Prior to the real session, a pilot study was conducted with four persons. The pilot study helps to validate the accuracy and completeness of the questions and determines the feasibility of the session. The feedback drawn from the pilot study was used to improve the planning of the real session.

The defined selection criteria of participants were set in order to guarantee that the gathered data is meaningful. The potential participants must possess some experience in agile software development and requirement prioritisation process. To fulfill this requirement, the study employed purposive sampling [84].

The researcher adopted a flexible trend as to the interview place and time to ensure the participation of respondents. While some interviews were conducted face-to-face, others were conducted through Skype. After the approval was obtained, invitations were sent by emails to the interviewees

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along with the interview questions. The informants were provided with the study purpose and their role as informants, and they were informed of the confidentiality of the information obtained from and their anonymity. Each interview session was recorded through an audio recorder with the informants' approval – the interview sessions lasted for approximately 30-70 minutes each.

As mentioned, the entire interviews were audio-recorded, with the interviewees' permission obtained prior to the interview after which the recording was transcribed into a text document. According to Morgan and Guevara (2008), audio recording is important for in-depth interviews as it provides an accurate record of the interview and according to other studies (e.g., [85-87]), the audio recording can be replayed, transcripts accurately documented, the record permanently preserved in its sequence and there it is an enriching detail of evidence. The researcher also made follow-ups through email and telephone to seek clarification of what was recorded.

Data analysis was carried out with the use of grounded theory coding techniques [88]. Coding refers to a process wherein data is fractured, conceptualized and integrated to create a theory [89]. With regards to grounded theory, data analysis is initiated by open coding and progresses to axial coding and selective coding [90]. The three mentioned phases enable the analysis of qualitative data in a deductive and inductive manner [89]. The coding methods are deemed to be technical analytical procedures [91] involving the encapsulation of insights, production of themes and creating theory from data [92].

The first level of the coding process in grounded theory is open coding. Open coding basically refers to the process of fragmenting, examining, comparing, conceptualizing and categorizing data [93]. Data break-down is carried out word by word, and line by line, and ultimately, the large text is coded [91, 94-95]. The above procedure it was employed in the present study, where open coding began with the second interviews after which the interviews are recorded and transcribed into documents. The documents where then analyzed word by word, and line by line to determine concepts and ideas that were labeled in order to elicit their interpretation.
The second phase of the coding process in grounded theory analysis is axial coding, and in this phase, open codes carrying different categories, concepts and dimensions are reformed. In this regard, Strauss and Corbin (1990) described axial coding as a set of procedures that places data back together in new forms following open coding, to make relationships between categories. Hence, the significance of this phase is the creation of relationships among categories and concepts to refine and differentiate between them [91]. Accordingly, the researcher proceeded to group the categories and form relationships among them after which comparisons were made between participants to determine similarities and differences in their viewpoint of the requirements prioritisation process in agile software development environment.

The final phase in the coding process in grounded theory is selective coding – this phase intends to form and discover the core categories that are significant for the theorization of the explored phenomenon [96]. The researcher therefore selects the main category and combines other main categories to it in order for a theoretical scheme to emerge.

Despite the seeming sequential order of the three phases, it is an iterative process for relationship identification [86]. According to Isa (2008), in grounded theory, data is not tested with the help of statistical processes but rather with the help of continuous comparative analysis via asking questions and comparing events and incidents brought out of the data.

4. RESULT

In the following sections, this paper presents the results collected from eighteen interviewees. The interviewees are from different software development companies with over one year experience, fifteen from a private software company, while three from public government agencies. In order to respect their confidentiality, we refer to the participants by numbers I1 – I18. All were using agile methods, specifically scrum and extreme programming (XP) – two of the most popular agile methods today [97-98] .
All of them were experienced in basic Agile practices namely iterative and incremental development with various iteration lengths, iteration planning, estimation and planning of user stories and tasks, testing, status report meetings (daily stand-up), and frequent release of working software. They were also engaged in requirements prioritisation process in varying phases – with some of the participants even being certified Scrum Masters.

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On the basis of their experience and work on agile projects, the eighteen participants held different levels of experience, with some fresh (first time in agile project), others experienced in working in many other agile projects. Some others had over 5 years of experience in such projects, with an aggregate of 183 years of software development experience and 69 years of experience in the development of agile software.

This paper selected quotations drawn from interviews that shed light on the concepts. Due to space limitations we cannot describe all the underlying key points, codes, and concepts from our interviews that further ground the discussion. As well as, the applied of 5S method to these issues. Every "S" is applied to every issue and its benefits as found from empirical study as shown in table 1.

4.1 5S Approach Contribution to get rid of Release Planning Issues

The findings indicate that, this phase includes several activities involving several critical characteristics of people so as to be implemented systematically. The first activity in release planning is defining the product requirements, which require a specific characteristic among product owners as well as clients; for instance, communication skills, knowledge (business, technical) and availability for both of them. Specifically, trust among people is one of the key concerns in defining the product backlog. Therefore, the product owner and clients should trust each other and for them to do so, each of them should have proper characteristics. This was illustrated by a scrum master who said that the product owner should have good communication skills to ensure trust relationship building.

Table 1: Empirical Findings for Appropriateness of 5S approach for the Humans Characteristics Issues and its benefits

Phase	Issues		5S Approach					Benefits
			S1	S2	S3	S4	S5	
Release Planning	PO	Low communication skills	×	×		×	×	Build trust , able to have visible backlog, prioritize backlog easily by extracting a business value and safe project schedule Easy to give visible and important backlog, located the budget, fix the scope and then save the budget and project schedule.
		Don't have technical knowledge	×	×				
		Don't have business knowledge	×		×			
		Unavailable	×	×				
		Inexperienced	×	×	×			
		Unauthorized		×				
	C	Don't have technical knowledge	×		×			
		Don't have business knowledge	×	×	×			
		Low communication skills	×		×			
		Unavailable	×	×				
		Unauthorized		×				
Sprint Planning	PO	Low communication skills			×	×		Capability to describe visible requirements, well-formed decision regarding sprints backlog priority. Able to determine the dependencies and accurate estimation for sprints delivery.
		Don't have technical knowledge		×				
		Don't have problem solving skills	×	×				
		Don't have team guidance skills	×	×	×			
		Inexperienced	×	×				
		Unauthorized		×				
		Unavailable	×	×				
	DT	Inexperienced	×	×				
Sprint Execution	PO	Don't have technical knowledge		×		×		Ability to guide and motivate the development team, ability to give the task with all dependence required. Ability to execute the sprint and deliver the sprint on time.
		Don't have decision making skills	×	×				
		Don't have problem solving skills	×	×				
		Unavailable	×	×				
	DT	Inexperienced	×	×	×			
		Low communication skills	×	×				
		Don't have ability to organize themselves	×		×			
		Don't have technical knowledge	×		×			
		Unavailable	×	×				
Sprint Review	C	Don't have business knowledge			×	×		Capability to be clear to the team, capability to increase the project schedule and budget. Ability to control the project scope.
		Unavailable	×	×				
		Unauthorized		×				
	PO	Don't have people influencing skills	×	×				
		Unauthorized		×				

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"The product owner who has good communication skills will build trust between himself and his clients" **I14.**
Thus, it so clearly appears that the **'S1'** is an appropriate phase to handle this issue by sorting, categorizing, and identifying the proper characteristic of product owner in regard to their communication skills. Subsequently, the **'S2'** or 'set in order' functions as a good phase in facilitating the selection of those individuals who have high communication skills, and hence, the **'S1'** along with the **'S2'** assist in overcoming the issues in the communication skills in defining the product backlog activity, which would ultimately improve the trust among clients and product owner.

One product owner further added that the technical knowledge of product owner influences the level of communication between the product owner and client (**I6**). This point was confirmed by another scrum master who claimed that the technical knowledge of product owner enhances the ease of use and convenience of clients and this would eventually build trust among product owner and clients.*"Technical knowledge for product owner shows the client his ability to work (achieve) what the latter requires, and thus, it builds trust."* **I14**.
The "**S1**" should be in place in order to determine the technical knowledge of product owner. However, in case there is a lack of technical knowledge, this issue can be avoided by applying "**S2**", which enables the product owner to set a development team who has a good technical knowledge to assist him in solving the issue and in turn, this is reflected on the product backlog visibility. This was mentioned by a product owner who said; *"Normally, when I am entering meeting or discussion where I know that technical issues that I'm not familiar with are going to be discussed, I invite the technical person to join me."***I6**.

Added to the above, business knowledge is a crucial characteristic that product owner should have to easily obtain business value and make a visible product backlog. This is confirmed by a consultant who was requested by the researcher to talk about possible issues in this phase; *Xi "Product owner doesn't always possess product knowledge or knows customer"***P17**. In the same vein, the project leader stated; *"Product owner does not understand his/her business domain."* **I15**.
Therefore, **'S1'** which is acronym as 'Sort' is employed for classifying and sorting the characteristic of product owner in regard to him/her business knowledge. Thereafter, the '**S3**' seems to be appropriate to apply, which denotes systematic cleaning and inspection to ensure a clean environment. This is because the product owner with business knowledge is a crucial in this phase for the identification of visible backlog and extraction of business value.

Similarly, one product owner argued that the availability of the product owner in this phase is considered an important characteristic to ensure the timely product backlog when he stated;*"the product owner who helps to get the requirement is often on holiday or on vacation. So, we have to wait…their absence could also depend on other things."***I12**.
Therefore, unavailable product owner might affect the project schedule. Thus, "**S1**" should be in place to sort the product owner availability and so "**S2**" can proceed to request for an available product owner to replace the absent one.

Likewise, the clients should also have some characteristics in this phase. In sum, to ensure that the product backlog is defined properly the client should have enough technical and business knowledge regarding their products to be able to describe the backlog by detail and make it more visible. This was supported by scrum master when he said; *"The client usually doesn't know what he wants in detail."* **I14**. This was also supported by a developer who claimed; *"The client lacks technical understanding; for instance, a client asked illogical questions like if he could send email after the cashier has finalized the receipt. After the request was heard, it appeared that the client wants to send notification to management, but because he the lacked technical background, he couldn't explain what he wanted. Instances like this make us confused and it affects the work environment."* **I11**.
Accordingly, the clients with technical knowledge characteristic are preferred to take part in this activity to define visible backlog. This issue can be addressed by applying **'S1'** to sort and categorize clients according to their technical knowledge characteristics. Based on the result of **'S1'**, the client who doesn't have enough technical knowledge characteristic should be replaced with one who has. This is in line with **"S3"** indicating that for a clean environment and handling of issues, clients should possess technical knowledge.

Moreover, business knowledge characteristic is equally important to technical knowledge. To this end, **'S1'** can contribute in this stage to dispose of the issue by sorting and identifying the proper

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characteristic of clients according to their business knowledge. Later, this could be followed by **"S3"** which cleans the environment and facilitates the overcoming of this issue and to define the backlog. This is supported by a consultant who argued that; *"Some clients don't have the domain knowledge and this is the most important problem we face. Therefore, we need to find somebody else."***I3**.

Additionally, high communication skills for the clients will help them to explain the backlog clearly and completely. This was supported by a project leader who stated that; *"sometimes the clients know what they want but they have difficulties in explaining the requirements in complete and clear statements."***I15**. Additionally, a consultant mentioned the low communication skills of clients that make it difficult for them to define the requirements boundaries; *"The most difficult problem the clients face is defining the boundaries of requirements, even though they know them."* **I17**. Thus, clients with high communication skills help to fix the requirements size, which in turn leads to commitment on the project scope and clear requirements. Therefore, in the first phase, the **"S1"** is suitable to distinguish between the clients according to their communication skills, and this is followed by **"S3"** that takes out the clients with low communication skills and change them with someone with better ones.

Also, to provide clear requirements all the details, clients should be available at this stage, because if they are not, this will lead to the misunderstanding among developers, which affects the delivery date of the requirements. This was mentioned by a developer; *"Lack of requirements clarity provided by the clients often arises as they are very busy and they have many things to do. So, they provide the requirements without details, lack of details or just general requirements, so much so, we have to take time to determine and understand what is needed"* **I11**.
In this view, **'S1'** is fit to determine the available characteristics of clients. Followed by the **'S2',** an acronym for 'set in order', to set the available characteristics of clients; this critical so that the clients contribute to the tasks of the product owner and development team in providing a visible product backlog.

The analysis revealed that, the activity that followed the product requirements identification is prioritizing the product requirements, where people who are responsible for conducting this activity must have some characteristics, considered as crucial characteristics, in order to do this activity smoothly and systematically.

On the whole, the product owner should have certain characteristics in order to prioritize the product backlog; these characteristics are experience and authority. In addition to this, the clients should have business knowledge and authority to prioritize the backlog effectively and efficiently as this will help the development team to implement accordingly.

The product owner's experience is a one issue that people face in prioritizing a product backlog. Product owners who are low in experience are not able to identify the business value of the backlog and are not able to prioritize them properly.

It is noted that an inexperienced product owner might be the reason behind delay in backlog prioritisation and this in turn, affects the business value definition. For this purpose, **'S1'** which is sorting and categorizing the product owner according to their experience characteristic, is followed by **'S2',** which advocates for selecting an experienced product owner to settle the backlog priority and technical issues. This was claimed by a developer who stated that; *"My greatest worry when dealing with business value and prioritisation is that most product owners don't understand how to define and stick to the definition of business value, and this is particularly true when I deal with new product owners"***I4**.
Afterwards, the findings showed that the **"S3"** can be perceived as an ideal solution to get rid of the issue of product owner's experience by replacing the product owner lacking in experience with another that has adequate experience in order to carry out missions required in this phase, such as organizing the requirements and taking well-informed decisions about requirements priority. This point was supported by a developer who said; *"When product owner was not be able to organize requirements and take good decisions to put all these in the right place, we used to replace him with someone who has experience to do so"* **I5**.

Another project manager added that the product owner should have the authority aside from the experience to make a timely decision in due course. So, top management should set in order **"S2"** the product owner with fully authority. He mentioned that *"If product owner is not empowered, chances are you will have delays."***I1**.

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It is equally important for the clients to have some characteristics including business knowledge and authority in order to prioritize a product backlog properly and overcome any issues that they might face during this activity. The next paragraphs explain the issues and the suitable **S** to overcome such issues revealed by the analysis regarding the clients.

Clients' business knowledge is an important characteristic that would help them to distinguish between the product backlogs and determine which one is more important, especially if there is limited budged and time. As mentioned by the product owner; *"If there is a tight schedule or small budget, we need to focus on, what's the most important requirement, so we can get it."***I12**. Also, this is supported by the general manager who claimed that; *"The business people need to highlight what is really important, if is really important we have to prioritize and allocate budget."***I10**. Similarly, according to a general manager; *"Very often the clients find it difficult to prioritize. They will say everything is important."* **I10**.
Accordingly, **'S1'** sorts the clients with more business knowledge followed by **'S2',** where the clients with high business knowledge are allowed to extract business value easily and evaluate the project schedule.

In the same vein, client's authority is also considered important in this activity, for them to be able to make a suitable decision at the right time and so as not to waste time asking the top management about the priority decision. In this regard, a project manager stated; *"Sometimes the person doing the requirement prioritisation doesn't have the authority and power to take a decision in priority and he/she should go back to the manager to discuss the priority of requirement"***I1**.
Consequently, the top management should set the authority for the clients in order to take the right decision directly and maintain the project by applying **'S2'**.

4.2 5S Approach Contribution to get rid of Sprint Planning Issues

Sprint planning is a consequence of the release planning phase that systematically divides a product backlog into prioritized sprints; this phase has some activities that should be done smoothly. Therefore, to achieve this phase without any issues, the human responsible in this phase should have several characteristics. Thus, this provides a discussion of the issues related to the characteristics of individuals.

Individuals are responsible for carrying out this phase, a product owner and development team and they need to possess certain characteristics. These characteristics as evidenced from the analysis are as follows: the product owner has to have communication skills, technical knowledge, problem solving skills; team guidance skills, authority, experience and he should be available. The development team has to be experienced.

In the first place the product owner has to introduce the requirements to the development team. Therefore, he/she should have very good communication skills to explain it clearly. As stated by a consultant; *"Product owner might be unable to describe the requirement clearly to the development team because he/she has problem in communication skill."***I17**.

As a consequence, the product owner is not able to explain the product backlog to the development team. So, this might lead to the detriment of developing an ideal product by the development team. This argument is supported by a product owner who mentioned that *"Product owner with low communication skills often provide unclear requirements, unclear product backlog, where the team becomes confused as to what they are building and consequently, they just build what they can as it is their job to so, without knowing why they're doing it, and thus, often times the result is a sub-optimal product."* **I6**.
It is evident that to bring tangible benefits of visibility in product backlog, the product owner has to have high communication skill and one with low communication skills should be replaced by someone else with high communication skills by applying **'S3'.** This cleans the environment to overcome the problem.

In addition to communication skills, the product owner has to have technical knowledge to be able to describe the requirements in more details to the development team. As claimed by a product owner; *"Sometimes the development team can challenge me and ask me regarding unclear requirements and they ask me to explain with some more technical examples or in clear written instructions for their understanding."***I12**.
It is obvious that, the **'S2'** is accurate fit to get rid of this issue in order to select a product owner with

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technical knowledge so that he is able to explain a product backlog clearly with more details.

Furthermore, as the analysis revealed, the product owner should have problem solving skills to be able to solve the issues that can be exhibited by segregation of conflicts between the development team members.. As claimed by a consultant; *"During the requirements prioritisation process in the division of the requirements session, we face a problem related to requirements like when X says we need this requirement as the highest priority, but Y says no we need this requirement – this problem was solved through the product owner's role."***I3**.

Support came from another delivery manager who argued that;*"Sometimes, we face some problems, such as when the same requirement gets different rankings and what we do at that point is get the people who have different rankings for same requirement (3 or 10) together in a room and hear their explanations. Then they will discuss to get one single ranking. This involves the participation of a product owner to solve the conflict."***I13**.

Accordingly, '**S1**' sorts, it should be applied for the product owner based on his/her problem solving skills, which later followed by '**S2**', in order to select a product owner who has problem solving skills to be able to segregate the conflicts between development team that might appear during the requirements prioritization.

In addition to problem solving skills, the product owner should be highly responsible regarding the product prioritization and regular delivery by having team guidance skills. This is strongly supported by a scrum master who stated; *"Sometimes, a person is appointed temporarily (1-2 weeks) as a product owner. After that, we discover he is not suitable for this position owing to his irresponsibility in delivering features and his inability to prioritize and illustrate the feature to the development team."* **I14.**

Certainly, the **'S1'** is more favorable to play a role in this situation by sorting the team guidance skills of the product owner. Later, the **'S2'** or 'set in order', should be apply in selecting the team guidance skills of product owner, which in turn could lead to a fruitful decision regarding the sprint backlog priority. In case the product owner does not have this capability, **'S3'** should be applied by finding someone else who has the team guidance skills to save the project schedule.

Analogous to communication skills, technical knowledge problem solving skills and team guidance skills, the product owner's experience is required for this phase to timely conduct prioritisation and to manage sprints. As stated by a system analyst and developer; *"Product owner takes a long time to manage the list and select the items for the next sprint."***I7**.

This is echoed by a project leader when he stated; *"Sometimes the person has no experience to take the right decision in terms of requirement priority and technical experience."* **I15**.

It is noted that an inexperienced product owner might give rise to delay in sprint backlog priority; this in turn, affects the project schedule. For this purpose, the **'S1',** which is sorting and categorizing the product owner upon their experience, has to be applied. Then, the **'S2'** which advocates the selection of experienced product owner brings about the settling of the sprint backlog priority and technical issues.

An authorized product owner in this phase is compulsory to take well-informed decisions about division of requirements owing to high risks. The scrum master supported that; *"There was a feature with many details and high risk so it needs more than a month to deliver it. So, the team decided to divide it to sub feature and deliver a part of it weekly. So, the risk can be reduced and distributed to its sub parts. However, the product owner should be an authorized person to give us approval."* **I14**.

Thus, without product owner's authority, delay could ensure in the feature delivery and the top management is a responsible for that. As supported by a project manager who mentioned; *"If the person is not authorized, we can't do anything because we have to get permission from the person who has the authority. Therefore, in this case the company manager or administrator shall bear this problem."***I1**.

In this point, the **'S2'** is a proper step due to play a crucial role in setting the precise authority of the product owner because such authority is considered significant for this phase in saving the project schedule by making the right decision regarding the risky requirements and dividing it into tasks to distribute the risk.

Lastly, regarding the product owner characteristic in this phase, availability of the product owners in all activities is incumbent for the processes to be done smoothly and systematically. A product owner argued that; *"A product owner has to be available both inside and outside, to continuously prioritize the backlog and sprints, and work constantly with the customers and development team."* **I12**.

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Therefore, the **'S1'**, an acronym for sorting and knowing the availability characteristic of product owner, should be applied after which '**S2'** sets the availability characteristic of product owner in order to avoid any issues during this phase, which cause the delay in the prioritisation of sprints.

The main role of the development team in this phase is to provide feedback to the product owner about the product backlog to help him divide it into sprints and prioritize it according to development team feedback. Therefore, the most critical characteristic that development team should have is the experience to be able to determine the sprints dependencies and deliver a tasks on time. As claimed by system analyst and developer; *"The sprints priority process focuses on dependencies between the sprints devoid of any error. This is extracted and determined depending on the development team's experience. Therefore, the development team should have enough experience for this process. Because, if there is a task be develop and there are other tasks depending on it, there will be a delay in this task, the tasks that follow, and the whole project."***I7**.
Similarly, another general manager pointed that; *"Normally, when we are going to identify the dependencies, we have 10 requirements, let's say, at the onset - we have to queue the requirements one by one and this is a part of development team work based on their experience. Let say in the fifth requirement, we realize that there is something that needs completion, in which case, we need to re-visit and release it. And yes this is of course affects the task in terms of cost, operation and maybe coding has to be redone that may expose it to risk and as such, the risk has to be addressed."* **I18**.
In addition, the development team's experience plays a crucial role in determining the risky requirements that help the product owner to decide, which requirements should be implemented first. As stated by a product owner; *"If there is something that development team is not able to do because of lack of experience, we consider it as risky. So, we want to address the issue earlier in the project rather than later."* **I12**.
Furthermore, the required time to implement a task is considered important in delivering a product or the project according to schedule. Therefore, the experience of the development team helps to estimate the completion time. This is supported by a project leader who claimed that; *"Sometimes the development team proposes the task completion to be 1 week depending on previous experience, but it takes 2 weeks – most of the time, this is the problem we face."* **I15**.
By relying on what has been argued by the participants, it seems that the development team's experience is crucial to be able to determine the dependencies between the sprints backlog and estimate an accurate time to deliver the sprints. This, in turn, benefits the smooth project implementation without issues. Therefore, the people who engage in this phase should be categorized and sorted based on their experience characteristic by using **'S1'**. After that, an experienced development team should be chosen, through the application of **'S2',** which is concerned about 'setting in order' the suitable characteristics for this phase to overcome the issues that people who work in this phase might face.

4.3 5S Approach Contribution to get rid of Sprint Execution Issues

Sprint execution is a phase that concerns the implementation of the highest priority sprint. Some activities should be accomplished efficiently to implement the sprint. These activities are under product owner and development team's responsibility. Therefore, these activities require specific characteristics of human that have to carry out these activities without any issues. Thus, this section discusses the issues related to the characteristics that might affect this phase in case the individuals do not have these characteristics.
These characteristics, as revealed from the analysis, are as follows: for the product owner, he should have technical knowledge, decision making skills, problem solving skills and he should be available, and for the development team, the members should possess experience, communication skills, self organization, availability and technical knowledge.

The first activity in this phase is distributing tasks by the product owner across the development team. Therefore, the product owner should have technical knowledge to distribute the task to the right developer with all details and required specification. Accordingly, the **'S2'** which speeds up the selection of product owner who have technical knowledge to guarantee distribute the tasks across development team with dependencies of those tasks and so on applied here. As stated by a developer; *"As a developer, I face some issues related to the dependencies. For example, I need the design of some tasks, but there is a delay in its provision. Also, our problems at the back end and consequently, this leads to delays and blocking. This means total turn off that is characterized by no*

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activity due to delay in design, which is under product owner responsibility. Therefore, the product owner with technical knowledge will help with this issue." **I9**.

Furthermore, the decision making skills is required for the product owner to be able to take the right decision as well as he/she is able to give the reward and punishment for the development team. As claimed by a system analyst and developer; *"A product owner who does not have the ability to make decisions and give the reward and punishment becomes an issue."* **I7**.
By relying on what has been argued by the previous participant, it seems that the product owner decision making skills is crucial to be able to take the right decision regarding distribute the tasks through the development team at accurate time to deliver the sprints. This, in turn, benefits the smooth project implementation without issues. Therefore, the product owner who engages in this phase should be categorized and sorted based on him/his decision making skills characteristic by using 'S1'. After that, an product owner with decision making skills should be chosen, through the application of 'S2', which is concerned about 'setting in order' the suitable characteristics for this phase to overcome the issues that might people who work in this phase might face

In addition, the product owner with problem solving skills make him/his be able to resolve issues that the development team might face during implementing a sprint.. As mentioned by a developer; *"I am, as a developer, should have the story with all clarifications and details – including the design and backend otherwise, implementation becomes impossible. So if there is any missing detail, I will directly tell the product owner and this becomes his responsibility. Therefore, the product owner who bears the responsibility solves any issue between the team members."* **I9**.

The compatible steps for this activity for the product owner who engages in this phase should be categorized and sorted based on him/his problem solving skills characteristic by using 'S1'. Followed by, 'S2' in order to set and identify the product owner according to his problem solving skills, which is important to get rid of dysfunction that will be reflected on the capability to solve the problem, guide and motivate the development team to execute a sprint in the required time.

Additionally, the available product owner in this phase is required to be able to help the team to implement and deliver the sprint. In case the product owner is incapable of doing so, he should appoint another person with full authority. As argued by developer; *"The product owner has to be available because if he is not, this could lead to disruption of the project, so in such cases, he should appoint someone else in position and grant him all the authority"* **I9.**
Another developer argued that the availability of the product owner might be low because, he/she has many activities to do. Therefore, top management should be careful in assigning a product owner who has ample time to be able to do his/her work in the proper way. He stated; *"The team leader does not have enough time because he has many tasks, such as follow-up programmers, analyst, and project status and maybe has another project to deal with."* **I11.**
According to that, the **'S1'** should be applied to sort and know the available characteristic of product owner for the sake of guiding and solving issues that may be encountered by the development team. In case the product owner is unavailable, the **'S2'** step appears to be appropriate to set the available person to play the role on behalf of the absent product owner to straighten out any issues reflected on the project schedule.

In the same importance, the development team should have several characteristics to do well in this phase. So, the first characteristic is enough experience of the members to be able to implement a task as required. As claimed by a product owner; *"When somebody new comes on the development team, it would take time for him to familiarize with the work and to provide optimal work level and that will affect our progress"* **I12**.
Also, a specialist's experience is required in some situations to deliver a feature on time. As mentioned by a programmer; *"in a mobile application, the team did not have any idea or experience about it; therefore we faced difficulty in the work and training on it. Thus, the employee needs to do self study on this new way of development and as a result, it will affect the project schedule. Therefore, a specialist developer is required to do this in a timely fashion."* **I16**.

It clearly appears that the development team experience is a seminal basic for this phase. Therefore, the **'S1'** is suitable to classify, distinguish and sort the experience characteristic of the development team and this is processed in sprint planning phase. This is followed by the **'S2'** to keep the development team with specific

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experience and task in the correct place, followed by the **'S3'** to focus on the cleaning environment by replacing the inexperienced development team by someone with more experience and letting the inexperienced development team to work in effortless tasks, get training or self study. This in turn would aid to overcome the issues and speed up the sprint implementation and stick to the project schedule.

Moreover, the members of the development team have to have good communication skill in this phase. As claimed by a product owner;*"Some development team is not communicate well, is very quiet and doesn't try to communicate and participate, does minimum work and consequently, this type of team is difficult to work with."* **I6**.
Since some tasks require high communication skill, the **'S1'** sorts out the development team characteristics depending upon their communication skill. Later, this is followed by **'S2'** to set a proper development team according to their communication skill for the task that requires this characteristic. So, 'S1' together with 'S2' collaborate to eliminate the issues in the communication skills at the task execution in order to deliver the task on time.

Beside from the above characteristics, self organized team member is required that because as a core requisite for agile methods and to show the collaboration between each other to achieve the task at hand. Therefore, the development team without self organized characteristic should be removed from this environment. This is addressed by using **'S1'** to sort and classify the development team characteristics according to their self organization. Afterwards, **'S3'** which symbolizes systematic cleaning of the environment from any issue that leads to disrupt the work environment is applied. Subsequently, execution time is improved in terms of the project schedule. As claimed by the product owner; *"If someone who doesn't know how manage time is part of the team, it could lead to issues, so thus, it is important for the team members to be technical-savvy, patient, helpful and collaborative. The members have to have the ability to cope very fast with the environment."* **I10**.

Furthermore, technical knowledge for the development team is crucial to be able to develop the task as required. This phase is related to the technical execution of the sprint, and to do so, the technical knowledge of development team should be in place otherwise the team member who does not have technical knowledge should stay out this environment. For this reason, the **'S1'** should be applied to sort and know the development team characteristic depending on their technical knowledge, followed by **'S3',** which is an acronym for 'Shine', indicating cleaning the development work environment to overcome any issues and keeping the development team clean by shifting who doesn't have technical knowledge to another place. As the scrum master claimed; *"Sometimes, we face a problem in terms of the lack of a member's technical background to achieve the task required from him."* **I14**.

Again the availability for the development team in this phase is important to deliver a task on time without affecting the project schedule. As a system analyst and developer mentioned; *"Sometimes we postpone a requirement because the specialist required is on leave"* **I7**.
This is also supported by a programmer who argued that; *"There is dependence between the requirements. If there is a delay in the first requirement, this will affect the rest of the team because they will have to wait until it is completed. This often occurs if a person works in more than one project or in the same project but he has another task that is required for him to deliver."* **I16.**
The consequence of unavailable developer or specialist gives rise to delay in some tasks, which in turn, affects other tasks depending on it and this would reflect on the project schedule. For this reason, **'S1'** helps to determine, classify and sort the proper characteristic of development team according to their availability and specialization. Afterwards, the role of **'S2'** comes to play, which is related to setting and identifying appropriate available and specialist developer for the required task. So, 'S1' followed by 'S2' contributes to get rid of any issues regarding the availability of development team.

4.4 5S Approach Contribution to get rid of Sprint Review Issues

Sprint review is the last phase in the agile software development and it concerns the acquisition of feedback from the clients about the sprint implemented by development team. This occurs during a session meeting between all humans interested in the implemented product. Therefore, this session requires specific characteristics that members should have, which is to provide suitable feedback about the sprint. Thus, this section explains the issues related to the

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characteristics that might affect this phase in case the members do not have these characteristics as revealed by analysis. Moreover, it also explains how the 5S approach contributes to overcome the issues.

The analyses show that the critical success characteristics for this phase are as follows: for the clients they should possess knowledge, should be available, and should be in authority, and for the product owners, they should have people influencing skills and authority.

The clients play a major role in this phase, by giving feedback on the sprint that has been implemented. Accordingly, they should have good business knowledge and know their product. In effect, clients who do not have good business knowledge about the product might lead to the need to change the requirement many times. This affects the project scope and thus, it is considered as a issue that could confront the humans who work in this environment. In this phase, the **'S3'** should be applied by cleaning, removing and replacing the clients with someone else with business knowledge and to protect the environment from any issue. As claimed by a scrum master; "*Some of the clients do not know what they want and ask for change many times because they do not have enough knowledge about their product and how it looks like. Therefore, we asked for a stand in, on behalf of the client, one that has more business knowledge about the product"* **I14**.
In addition, the available client at this phase should be able to give feedback about the product to the development team and product owner. As argued by the developer; *"The clients or the user sometimes do not have enough time to be close to the team to give us their feedback about the product that we have to develop for them."* **I11**.
Agile environment is characterized by getting direct feedback from the clients and they should be close to the team. Therefore, the **'S1'** is applied for sorting the available clients to be used. Then after that, **'S2'**, which is acronym for 'set in' the right client in order to keep him/her close to give feedback when needed. This might help to enhance the presence of the client and get rid of the issue.

Over and above, the client with authority is preferable to be in this session feedback. That might save the project and lead to timely decision making regarding the project schedule and budget. The general manager supported this by stating; *"After a few weeks, the development team becomes ecstatic of the big and complex project that could take longer to develop than expected, but the budget and deadline have to be maintained, so the final decision depends on the clients."* **I10**.
In this regard, in order to overcome this issue, the **'S2'** is fit to be applied, which stands for giving and setting the authority characteristics of the client who would be close to the team in this phase. So, the client is enabled to make the right decision regarding the complex requirements, which in turn, could protect the project schedule and budget.

Interestingly, the most important characteristic of product owner in this phase is people influencing skills to be able to discuss with the clients about requested features during the sprint review session in order to convince them. Thus, 'S1' helps to determine, classify and sort the proper characteristic of product owner according to their ability to influence the people. Subsequently, 'S2' is suitable to work well in this phase, as it selects the correct person to act as a product owner – one that is characterized as having a people influencing skills, in order to protect the project scope as agreed between the humans and to get rid of any issues that might be faced during this phase. As mentioned by a developer; *"I would say maybe the product owner influence people or have that ability is preferable to selected. Sometimes a lot people don't have a lot of authority that we looking for but he has the ability to influence the people"* **I12**.

In addition, the developer further adds that the authority of product owner will help make clients to be committed to their requested features. Thus, **'S2'** acts very well to set in the product owner with high authority to be capable to make a decision regarding the sprint preview and overcome whatever possible problems that appear. He mentioned that; *"If we have strong and powerful PO with full authority to lead committed clients of what is written, all will proceed smoothly, but unfortunately, PO does not have full authority and power in the final decision."* **I9.**

5. THE PROCESS MODEL

Based on the analysis of empirical studies that have been conducted, the proposed process model is developed based on 5S approach as shown in Figure 2 The proposed process model was made up of two aspects, namely human and process. The human aspect involves three factors identified the Product owner, Development Team and Clients, while the process aspect consists of four phases, namely the release planning, sprint planning, sprint

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execution and sprint review. There are three factors contained in the phase of release planning which are defined product requirements, prioritization of product requirements and criteria. The sprint planning phase involves two factors, namely dividing product requirements into sprints backlog and prioritize sprints backlog. Further, the sprint execution phase contains distribution of tasks to the development team and implementing the sprint. Meanwhile, feedback and re-prioritisation factors found to be involved throughout the phases of sprint review. The proposed process model shows how each of these factors and elements contained in different aspects or phases correlated with each other.

In addition, each phase in the process has some activities which are required different roles from the human aspect and also need specific characteristics to overcome any issues may occur to be more systematic and organized. Therefore, the 5S approach play a significant role in organization the environment by classifying and cleaning the environment from any issues that might occur. For instance, in the phase one (Release Planning), the first activity is define the product requirements that happen between product owner and clients and to do so, the 5S approach classifies human based on their characteristics to be capable of achieving the activity smoothly and systematically. This involves the application (S1,S2) to technical knowledge, communication, availability for Product Owner, the application of (S1,S3) to business knowledge for Product Owner and (S1,S3) to Communication, technical knowledge for Client and finally, (S1,S2) availability for Client. This means the product owner with technical knowledge, communication, availability and business knowledge should be capable to extract the product requirements from the clients and built a trust. Moreover, communication skills, technical knowledge and availability of the clients contribute very well in this activity and help provide clear and detail requirements.

Regarding the "S4", it should be applied to the whole phase to standardize the environment in terms of best practices which is, selecting the suitable person with accurate characteristics for this phase and systematically conducting the processes and procedures. For instance, in the release planning phase the human who involved in this phase should be standardized based on their characteristics which are; knowledge, communication, availability, experience and authority for product owner as well as knowledge, communication, availability and authority for the clients. Finally, the 'S5', acronym of 'Sustain', acts as the toughest stage to execute and realize. It is important never to return to the relaxation of old ways of accomplishing things. This necessitates the team taking steps to ensure 5S develops deep roots in their environment and becomes the normal way of doing software development involving 'S1' sorting, 'S2' setting in order and 'S3' shining the members with regards to their characteristics constantly and sequentially.

CONCLUSIONS

The agile software development environment is iterative and incremental based on individual and responding to change very fast as claimed by agile manifesto. This is happened by requirements prioritisation process to decide which requirement should be implemented first. Once the prioritization and re-prioritization requirements occurred frequently and iteratively lead to unsystematic and disorganized environment. The 5S approach is design to organize the environment by playing an essential role in eliminating the waste and issues which providing a better comfortable and safe environment for the people who worked on it. This paper discussed the issues that might affect the process regarding the human characteristics. The study is based on empirical approaches to deep understanding the issues that might occur during this process through semi structure interviews with experts in the field. To obtain the best results, the data were analyzed by using grounded theory techniques (Open, Axial and Selective coding). The findings indicate that there are two aspects involved in the requirements prioritisation process in agile development, namely human and process. The human consists of three factors, namely product owner, clients and development team. The process outlines the activities involved in the requirements prioritisation process, which required a specific characteristics and different role to be executed systematically by applying the 5S approach to all the identified issues. The process model designed to implement the requirements prioritisation process in agile development environment systematically.

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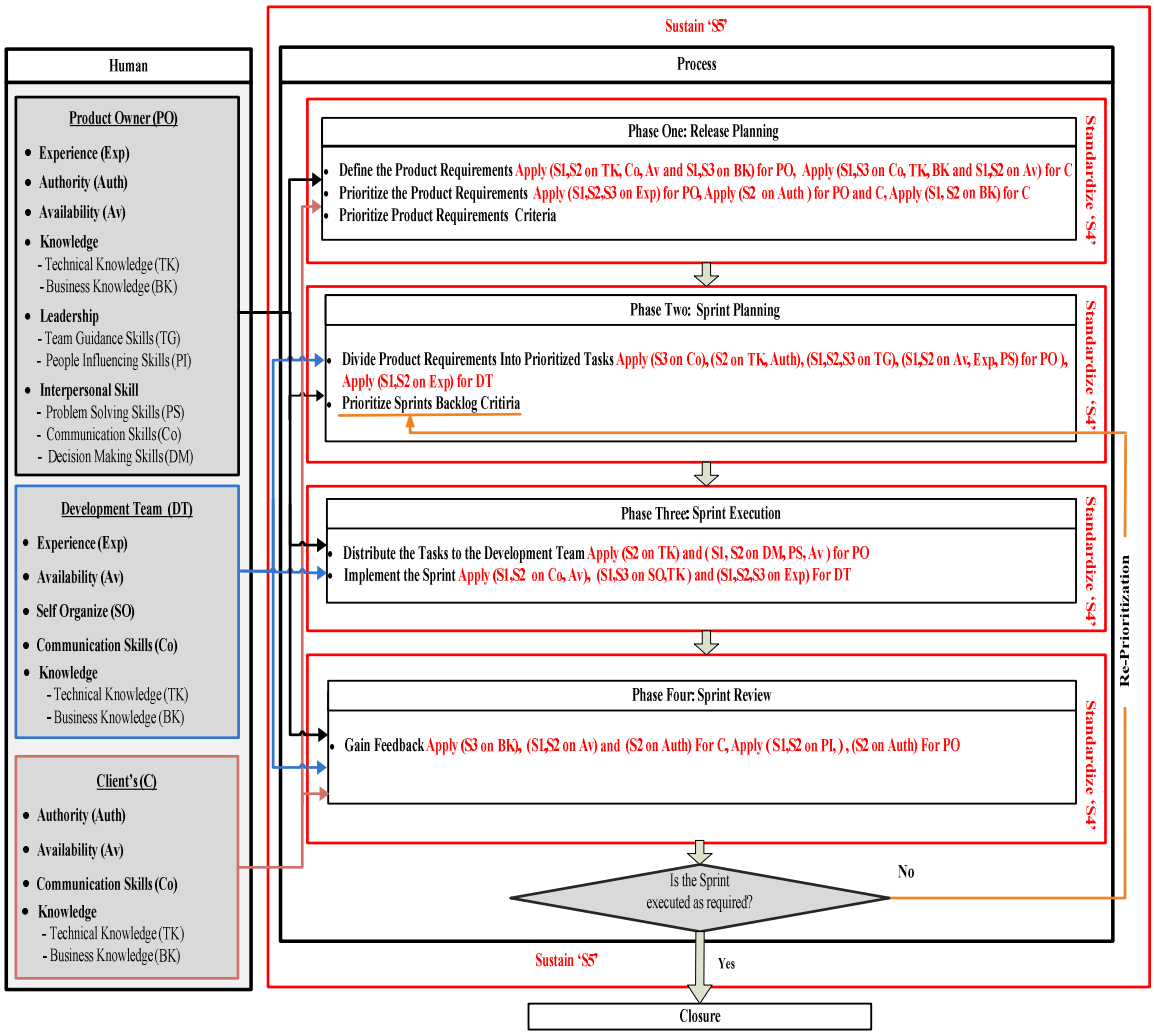

Figure2: Requirements Prioritisation Process Model Based on 5S Approach

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