
Task process reference model on elderly's lifestyle for cluttered homes of the elderly in Northern Thailand

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Abstract: The cluttered home conditions are a significant risk of falling in older people who spend most of the time in their house. Therefore, this study proposes new elderly's lifestyle task model (ELTM) with risk assessment method under scoping of the quality concept. The research was conducted in Sri Bua Ngern Village, Tha Sala District in Chiang Mai, Thailand. The basic activity of elderly lifestyle in the house was analysed, verified and validated into daily tasks. Then, the elderly risky lifestyle task of the cluttered home management was evaluated to find the maturity level. The maturity level in the elderly risky lifestyle task was increased by implementing 5S practice. This research exercise shows clearly that the ELTM reference model represents daily living tasks of the elderly in their own house. In addition, the five levels of maturity assessment can measure the elderly's capability in preventing the risk of falling.

Keywords: elderly's homes; process reference model; risk assessment method; Thailand.

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1 Introduction

Because of the rapidly-increasing global elderly population, many countries in the world are facing an aging society situation; therefore, preparations to deal with this situation should be an ongoing process. Thailand was classified as an ageing society in 2009 (Chuharas et al., 2009). From *The 2nd National Plan on the Elderly (2002–2021)* of Thailand, it indicated a strategy on readiness preparation for quality aging (The National Commission on the Elderly, 2009). The environment is one factor affecting the quality of life of the elderly, especially, the household environment which is a basic factor in everyday life. Aging in place may be defined as “the ability to live in one’s own home and community safely, independently and comfortably, regardless of age, income or ability level” (Centers for Disease Control and Prevention, 2013). A home’s environmental condition is a very important factor which enables older people to live with independence, safety and comfort.

Appropriate and secure home environments for elderly are necessary to afford a good quality of life. A home environment plays an important role in an elderly’s health because they often spend a significant time indoors. As people grow older, they have a higher risk of falling. Falling in the elderly is common and can be a leading cause of injuries and death. Many studies link injury with hazards in the home (McLean and Lord, 1996; Lord et al., 2006; Todd et al., 2007). In Thai society, most the elderly live in their house that the home environment is significant factor of health and wellbeing of remaining living at home. Chuharas et al. (2009) reported that the most common causes of falls for Thai elderly were slipping followed by tripping. A hazard in the home is a source of danger and risk of harm. Many home hazards are related to clutter. Cluttered homes collect dirt, provide hiding spots for pests and can cause trips or falls. Its management is a target in reducing morbidity and mortality in elderly. The elderly have problems in managing clutter in their houses which can lead to the risk of falling.

A process reference model is an abstract framework of an interlinked set of the standard processes developed to encourage obvious communication (Altekar, 2005). Thus, a set of generally-accepted best practices of this model can create efficient to be deployed inside organisations. ISO/IEC 15504 combines the ISO 9000 approach with the capability assessment and process maturity features of into a single mechanism to develop a quality system for software (Madachy, 2008). This concept can adapt to become a generic process assessment standard. Due to enhance the safety environment for the elderly, this basic principle of a process reference assessment is applied for the elderly to assess themselves how well processes performance. Thus, the process reference model is the standard management practice to manage unused items in elderly's houses. This study aimed to develop a process reference model for elderly's lifestyle that allows a senior resident to manage the risk from unnecessary household items from assessment method.

2 Literature review

Process reference models integrate the well-known concepts of business process reengineering, benchmarking and process measurement into a cross-functional framework (Phelps, 2006). Moreover these provide a consistent framework for processes that an organisation can choose to improve for achievement of the desired results. A process is a sequence of activities and associated tasks required to meet goals or objectives (APQC, 2013). Examples of process reference models are the ENUM process reference model in the telecommunications industry (Cannon, 2002), Petrotechnical Open Software Corporation (POSC) business process reference model in the petrochemical industry (Cover, 2001) and the supply chain operation reference model (SCOR) (Altekar, 2005). Reference models help accomplish many goals including: mapping telephone numbers to internet services, improving business performance and risk management. Process assessment enables identification of the process capability and based on the assessment results, leads to an enhancement of the process by identifying the process strengths, weaknesses, risks and risk prevention (Loon, 2004). An assessment is carried out by evaluating selected processes using the chosen assessment model. The ISO/IEC 15504 part 2 technical committee reports released in 1998 presents the minimum requirements to become an international standard for software assessment (ISO/IEC 15504-2, 2003). This assessment model has to be compatible with the requirements defined in ISO/IEC 15504-2 and is selected according to the application domain of interest. This process reference model can develop to improve the safety performance of older people who are living in the house, that process of house living represent everyday risky tasks of the elderly.

The capability maturity model (CMM) is based on knowledge acquired from software process assessments and extensive feedback from both industry and government. The initial release of the CMM, Version 1.0, was reviewed and used by the software community during 1991 and 1992 (Paulk et al., 1993). Release of the capability maturity model integrated (CMMI) version 1.3 was reported in 2010 (CMMI Product Team, 2010) to provide guidance for applying CMMI best practices in organisational development. It has been generalised and can be applied to any of a wide variety of processes in diverse organisations. This framework structure is based on principles of product quality

evolving through five maturity levels for continuous process improvement. The corresponding stage models have been adopted, but still face a challenging task when searching for the right measures to improve the business process management capabilities (Röglinger et al., 2012). It extends the insights into qualities and components by focusing on the applicability and usefulness of maturity models. The maturity model can provide a holistic view covering relevant issues, however, typical maturity levels depend on company characteristics. According to Frick and Schubert, (2011), it is necessary to understand all relevant criteria for the assessment of the specific domain that the maturity model is designed for based on three factors (technological, organisational and institutional). CMMI continues to be widely applied as a general model of the maturity process. The maturity model can expand to measure the level of cluttering home environment management of the elderly for scoring process.

The main focus of this standard is on process assessment of three objectives: determine process capability, process improvement and a clear description of processes being assessed. The requirements help ensure that the assessment output is self-consistent and provide evidence to substantiate the ratings and to verify compliance with the requirements. The standard provides a universally-applicable process assessment model and method that covers multiple process assessment methods and models by setting requirement for compliance and conformance. This assessment model concept applies to the development of a process reference model to create the safety environment for Thai ageing society.

Many studies have developed and adopted reference models for improvement of their organisations and products. Hauck et al. (2011) proposed an ISO/IEC 1554-2 compliant method for process capability/maturity model customisation whereby an expert panel indicated its usefulness and adequacy for the customisation of software process capability/maturity models, such as, for medical devices as well as software processes within the medical device industry. Blashka (2011) used the process reference models in business to create standards and supports key components of quality systems and improve both quality and profit. Zapp et al. (2012) presented a reference model which outlines measures for the dimensions of strategy, processes, technology and IT systems. This reference model enabled more collaborative supply chain planning and improved control in the automotive and semiconductor industry. Al-Khiaty and Ahmed (2013) proposed a framework for building a state-of-the-art reusable reference model that can enhance the proposed reference model with the learning ability to improve its quality and reusability. Reicher et al. (2013) introduced the reference process model by making use of existing data or documents as an overarching approach for bringing the management of master data into organisations using a process view and linking the processes to responsibilities (data governance). As supported by Vavillis et al. (2014) proposed a framework for the analysis of reputation systems to measure of the trustworthiness of users in online communities. The requirements and features used to form a reference framework which allows an objective evaluation and comparison of reputation systems. The reference models can facilitate the development of effective strategies that enable organisations to overcome new challenges. In this study, the analysis was conducted based on the theoretical principles in this model.

The 5S practice can be done through implementation for quality improvement (Sorooshian et al., 2012; Puttapalli, 2014). Ab Rahman et al. (2010) reported that 5S practice through auditing process is seen as an effective technique that can improve

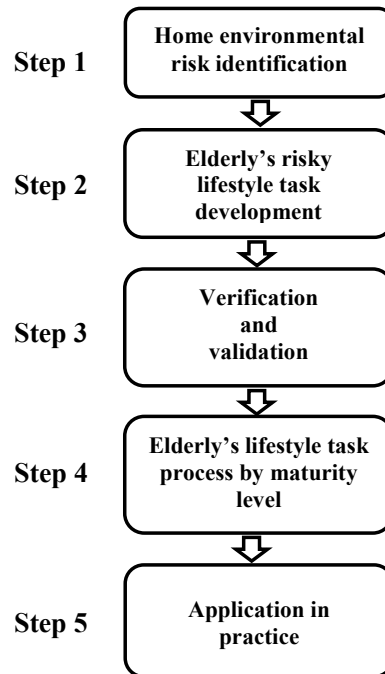
housekeeping, environmental performance, health and safety standards in their workplace. As supported by Ablanedo-Rosas et al. (2010), the 5S practice plays an important role facilitating the basis for advanced quality and continuous improvement of all activities and operations; the design of processes to track, measure and evaluate the implementation. As Kumar and Kumar (2012) confirmed that 5S is an effective tool for the implementation emphasising on the benefits to improve productivity and reduce both waste and lead time by using the P-D-C-A cycle approach. The 5S practice is a technique that can improve housekeeping, environmental performance and safety standards in a systematic way to maintain quality environment in an organisation effectively. Then, in this study 5S practice is a solution as an effective tool for improvement to solve the problems, which are caused by the messy environment, for enhancement of human capability and productivity and also to save more money.

From a previous study on environmental hazards in the Thai housing of elderly people, a main problem was cluttering of areas such as hallways causing obstructions and in rooms where it restricted movement, access to appliances and clearance of the floor (Putthinoi and Chakpitak, 2011). In addition, Thai style houses do not typically have storerooms, things are stored in free spaces (Bestroomstyle, 2011). From this reason, accumulation of household items is common around the Thai house and becomes a hazard risk factor for falling. Assessment and modification of housing is needed to increase the environmental accessibility and remove architectural barriers to independence and safety. This process can often be cost-effective depending on the environment or structure and the specific needs of each individual. Management of unnecessary items in elderly's homes is essential; this management can reduce fall hazard risk with low budget. Risk assessment may lead to risk management. Risk management deals with a broader evaluation of the results of the risk assessment. 5S is a tool of the management that can create an environment which is comfortable, clean and safe in the organisation (Moulding, 2010). In this study, 5S is a tool in part of quality improvement.

Furthermore, the assessment is impact to manage the accumulation of household items on the health and safety of the elderly. This study aimed to develop a new assessment model by proposing a process reference model for quality management. Therefore, it is essential to systematically reduce the risk from accumulated of cluttered household items. This paper provides a reference process model of the proposed risk assessment method based on the elderly life style.

3 Methods and methodology

This ELTM model was developed to provide a risk assessment method on unnecessary items in elderly's house. The assessment model in Figure 1 is the proposed the ELTM model of risk assessment method on management the cluttered items in elderly's houses. The construction of a reference model method of this process reference model was carried out according to Blecken et al. (2009) in five steps, identification, lifestyle task development, verification and validation, process task maturity level and application in practice as presented in Figure 1.

Figure 1 The development method of the ELTM model

The research described in this paper mainly focused on home environmental risk of falling in elderly. The first step aimed to identify the home environment risk by using an expert panel. A multi-disciplinary team consisted of three experts from other areas, geriatrics, housing and environment and community. They were qualified participants in this study through experience in this area for at least five years. Scope of identification was under main three keywords, home environmental risk, elderly and falling.

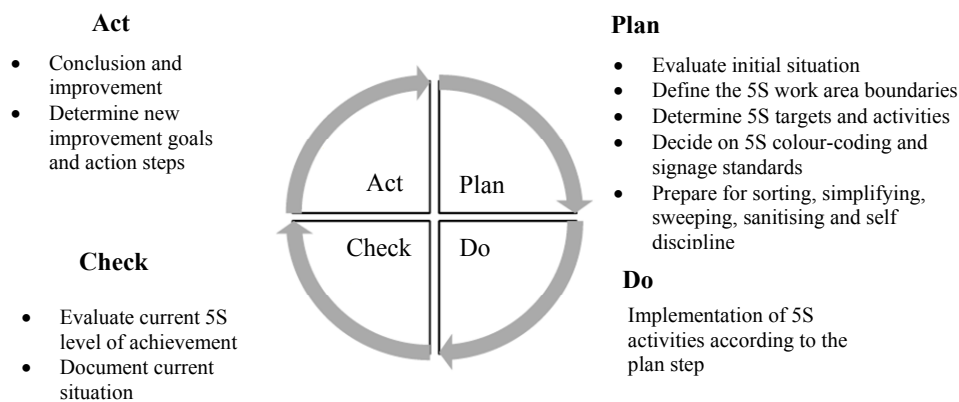
The second step was to investigate the elderly's lifestyle in their house. The investigation included literature reviews, review and synthesis of knowledge of Thai older people from 2001 to 2007 (Vitchavut et al., 2010), situation of the Thai elderly 2009 (Chuharas et al., 2009) and situation of the Thai elderly 2010 (Chunharas, 2012). Nine activities of elderly lifestyles were identified according to the literature reviews. The proposed elderly lifestyle tasks were validated within a focus group. The focus group was conducted for validation of propose tasks by six members because this method is constructed for subjects who have homogenous characteristics (Krueger, 2002). The six members included three experts and three elders. The elders were selected from each of three age ranges: 60–65, 66–70, over 70 years. The inclusion criteria of selecting the elderly were retirement, householder, owner and living in their house and taking the management role in the house. However, identification of activity is determined similar the general basic activity of their daily life in the house.

The third step of the design process focused on verification and validation. This step was conducted by the all day, in-home observation of the elderly's lifestyle behaviour in the real situation of Tha Sala community. This observation was carried out to check the tasks of person's lifestyle to ensure that the developed model was correct and accurate for all possible conditions.

The fourth step comprised the process outcomes requirement. The requirement is considered a potential outcome for the processes of each task. The outcome process was written according to each life style task in house of the elderly under the concept of the capability maturity model (CMM/CMMI framework) (Paulk et al., 1993; CMMI Product Team, 2010). The process outcome of elderly life style was developed into a documentation form by the expert panel. The experts were interviewed in order to analyse quality and performance needs. Then, the experts identified relevant processes and basic practices with respect to the identified quality and performance needs.

The fifth step consisted of the use of examples to explain the application and use of our approach of this ELTM model. The municipality was the area to test the application of this particular reference model. The reference model was an assessment evaluation at houses of the elderly in the Sri Bua Ngern Village of the Tha Sala municipality in Chiang Mai, Thailand. This village has 71 households of elderly residents according to the elderly living allowance database system for the year of 2012. The selection criteria for the houses of elderly residents were the same as indicated above. Thirty five houses of the elderly who met the criteria were evaluated by using the elderly risky tasks reference model. The risky housing environment was improved using 5S techniques. The 5S audit checklist is developed in grounding all 5S requirements and practices in the elderly house for self-evaluation by the elderly as internal audit. Validity of the task of 5S checklist is conducted by DEPHD of Tha Sala municipality. The comments and feedback given were very useful in enhancing, rectifying and improving the 5S checklist.

Figure 2 Implementing 5S with P-D-C-A cycle



This 5S practice is generally a technique to eliminate hazards and waste in the house and create a safer, cleaner and healthier environment. Five households of the elderly agreed to participate in the 5S implementation. These participants covered all family and house characteristics; nuclear family, extended family with grandparents, extended family with grandparents and unrelated individuals. Podhisita (2011) and Mahaarcha and Kittisuksathit (2009) reported on the nature of the family and household in Thailand. The case studies used in this research represent an initial step to a larger investigation. These case studies can provide an important opportunity to develop the evaluation questions, measures, design and analytical strategy for a possible larger study. It is particularly useful since there is some considerable uncertainty about processes, goals and results to

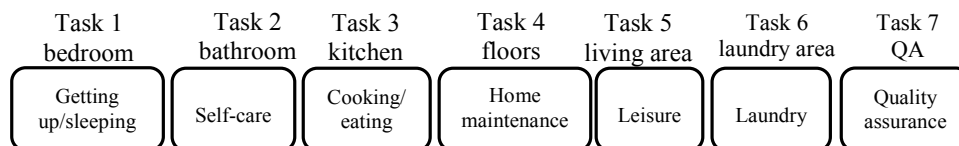
be achieved due to the initial state of research (GAO – United States General Accounting Office, 1990). Thus, for this evaluation, a case study design was used for experimentation. The improvement activity was conducted under the 5S activities. 5S management fit the requirements of daily living in houses of the elderly very well according to theoretical reviews. The PDCA (plan, do, check, act), or ‘Deming cycle’, of implementing 5S is an integral part of process management. This is a never-ending activity and has to follow a process approach (Figure 2).

In order to start implementation of 5S, each phase must be thoroughly analysed and addressed using the P-D-C-A cycle approach. The implementation plan can improve the process activity tasks to reach an increased maturity level. The finishing implemented houses of the 5S process were evaluated for outcome by the elderly risky tasks reference model.

4 Results and finding

The first step aimed to identify the home environment risk of falling in the elderly. Experts classified the home environment risk into three levels; high, medium and low. The medium risk from unnecessary items within the elderly’s house was identified by this study. First, nine typical elderly tasks were identified. Then validations by focus group identify six main life style activities. In addition, task seven is a quality audit. The seven tasks are presented in Figure 3.

Figure 3 Seven tasks of elderly life style



The figure shows the process as it is known within the elderly who live in the house. The living activity process starts with getting up in the bedroom. The details of each analysed task pertaining to basic activity of daily living of the elderly are presented in Table 1.

Table 1 The seven tasks of elderly lifestyle

<i>Task</i>	<i>Place</i>	<i>Detail</i>
1 Getting up/sleeping	Bedroom	Getting up from bed in the morning and going to sleep including other activities in bedroom i.e., grooming dressing
2 Self-care	Bathroom/toilet	Showering or bathing, washing face, brushing teeth and using the toilet
3 Cooking/eating	Kitchen/eating area	<ul style="list-style-type: none"> Preparing for cooking, cooking, washing and storing Setting table ,eating, feeding oneself
4 Home maintenance	Floors/ connecting areas	Sweeping, cleaning, mopping and waste management

Table 1 The seven tasks of elderly lifestyle (continued)

<i>Task</i>	<i>Place</i>	<i>Detail</i>
5 Leisure	Living area	Sitting leisurely, relaxing, reading print media, listening to audio media, table top games and watching television , playing with children including other activities in living area
6 Laundry	Laundry area	Folding or hanging clothes, putting clothes in washer, washing clothes by hand, drying clothes in the air and ironing
7 Quality assurance	--	Covering internal quality assurance and external quality assurance of elderly lifestyles tasks

These processes involve the typical activities of the elderly residents in this community. The results were validated in a second step through the all-day behavioural observation. The main objective of this validation was to evaluate the life style task of the elderly to develop the first version of the model. The result was a first version of the process model. The process outcomes of elderly life styles of the six studied tasks were categorised using the elderly lifestyle task maturity levels as indicated in Table 2.

Table 2 Description of the elderly lifestyle task by the maturity level

<i>Task</i>	<i>Level</i>	<i>Process outcome</i>
1 Getting up/sleeping	0	Cluttered home management process areas are not satisfactory, incomplete process
2 Self-care	1	<ul style="list-style-type: none"> • Do cleaning and maintenance in each of the tasks
3 Cooking/eating	Initial	<ul style="list-style-type: none"> • Do, but no systematic procedure, satisfies the specific goals of the process area
4 Home maintenance	2 Managed	Have action plan and schedule for clutter management and act accordingly
5 Leisure	3	<ul style="list-style-type: none"> • Have action plan for each of the tasks for management of home clutter
6 Laundry	Defined /PDCA	<ul style="list-style-type: none"> • Evaluate the cluttered home environment for goal achievement, problems are dealt with using a defined PDCA timeline • Have action plan to improve the cluttered home environment for more efficiency • Process improvements for the cluttered home management may be initialled to focus on implementing for best practices
	4 Quantitatively managed/ measurement	<ul style="list-style-type: none"> • Sets quantitative and quality goals for control of cluttered home according to each task • Productivity and quality are measured for important process activities • Have indicator to manage the cluttered home environment • Indicator analysis for improvement

Table 2 Description of the elderly lifestyle task by the maturity level (continued)

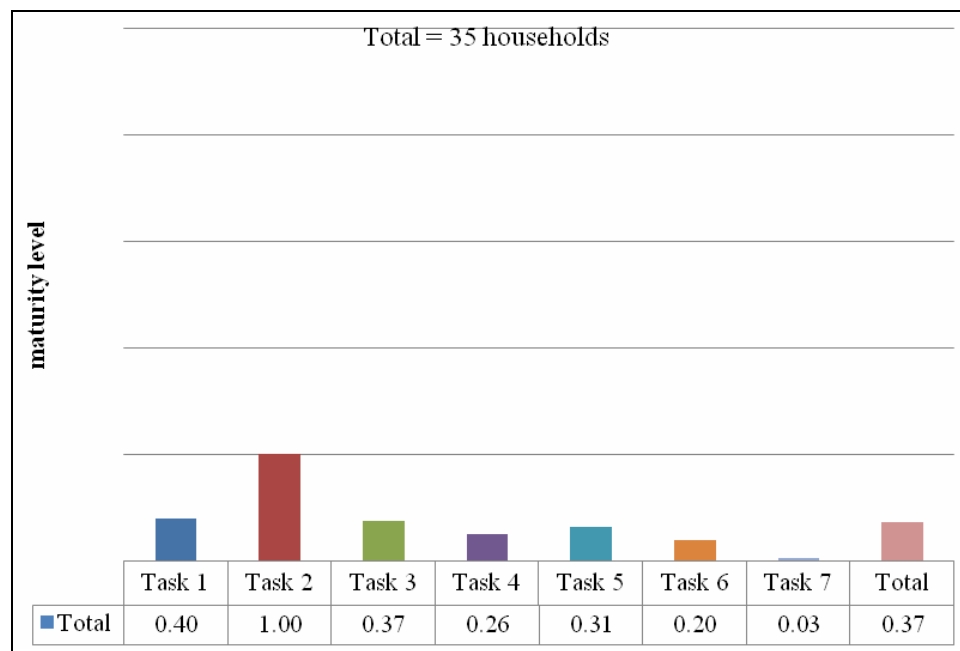
<i>Task</i>	<i>Level</i>	<i>Process outcome</i>
7 Quality assurance	5 Optimisation and innovation	<ul style="list-style-type: none"> • Have conclusion and analysis of process outcome • Have to use experience about the cluttered home environment management to improve the management for more efficacy and efficiency • Have to apply principle of 5S (environment management) to improve the cluttered home management for more continuous process improvement
	0	No cluttered home management process
	1 Initial	<ul style="list-style-type: none"> • Have to understand all guidelines about quality assurance improvement of the cluttered home management • Have to do quality assurance processes implementation
	2 Managed	<ul style="list-style-type: none"> • Have to manage the audit process concerning the cluttered home • Report QA plan and measurement of all six tasks
	3 Defined	<ul style="list-style-type: none"> • Process improvements may be initiated based on QA findings/recommendations • Consolidation and reporting of QA results at process completion • Beginning to focus on implementing best practices
	4 Quantitatively managed/measurement	<ul style="list-style-type: none"> • Adequate quantitative visibility including identifying improvements • Changes are implemented to improve the quality of processes
	5 Optimisation and innovation	<ul style="list-style-type: none"> • Focused on continuous quality improvement by quantitative feedback • Able to identify weaknesses and the means to strengthen the processes

Maturity models are widely used in process improvement of the ELTM model. Process outcome of the elderly lifestyle tasks are defined in five levels of process maturity. A key decision in building a maturity level is the underlying quality model of the CMM/CMMI framework of the Software Engineering Institute (SEI) (CMMI Product Team, 2010). Task performance at level 1 does not support processes in any significant way and is immature. Level 5 of task performance is completely mature and has mastered the use of the processes.

Tha Sala municipality in Chiang Mai, Thailand was the site of the case studies to investigate and develop the ELTM model of risk assessment method for unnecessary items in elderly's house. Thirty-five households were investigated to test this process reference model.

Table 3 Demographic data of households of the elderly in Sri Bua Ngern Village

<i>I</i>	<i>Elderly houses</i>	<i>No. houses (N = 35)</i>	<i>(%) percent</i>
1	House characteristic		
	One story	16	45.72
	Two stories	18	51.43
	Single story high raised basement	1	2.85
2	House's age (y)		
	1–10	9	25.72
	11–20	12	34.28
	21–30	11	31.43
	31–40	3	8.57
<i>II</i>	<i>Elderly persons</i>	<i>No. elderly (N = 46)</i>	<i>(%) percent</i>
1	Sex		
	Male	16	34.78
	Female	30	65.22
2	Age (year)		
	60–70	19	41.30
	71–80	20	43.48
	81–90	7	15.22

Figure 4 The task process maturity level of the elderly households in Sri Bua Ngern Village (see online version for colours)

The ELTM model was used to evaluate in the community of 35 elderly households (Figure 4). A large part of elderly households in this community were between level 0–1, according to the application scale of the CMM. The lowest average score was 0.03 in task 7 (quality assurance) whereas the highest average score (1.00) was in task 2 (self-care). The average score of total all seven tasks was 0.37.

These community elderly households were at a low level in task process and not mature enough to realise the need to build a process construction covering all processes in undertaking basic household maintenance. They needed a methodology to help them build process structure to be able to easily manage and measure processes and promptly identify the need for change in this environment. These elderly were not in a condition to routinely improve their processes so that they could be sufficiently adaptable. They needed to develop organised and documented processes and to understand how management and support activities could be used for uncluttering households.

If organisations wish to achieve improvement, they need to use appropriate selection of quality tools and techniques. 5S is a methodology for creating and maintaining an organised, clean, safe and high performing in a better environment. It is a tool to improve efficiency and quality for maturity. Five households of the elderly from 35 households responded to participate in the improvement of their environment task process with 5S Management as shown in Table 4.

Table 4 Characteristic of five case-study houses

<i>Case study</i>	<i>Family structure</i>	<i>No. older people</i>	<i>Type of housing</i>	<i>House's age</i>
House 1	Extended family with adults	2	Two stories	14 years
House 2	Unrelated individuals	1	Two stories	33 years
House 3	Extended family with grandparents	3	One story	27 years
House 4	Nuclear family	2	One story	20 years
House 5	Unrelated individuals	1	Two stories	21 years

Table 5 Pre and post of 5S implementation outcome in five case studies

<i>Task</i>	<i>Detail</i>	<i>House 1</i>		<i>House 2</i>		<i>House 3</i>		<i>House 4</i>		<i>House 5</i>	
		<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>
1	Bedroom										
	1.1 Cleanliness, orderliness and neatness of room	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes
	1.2 Appropriate bed height and width	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	1.3 Bed placement, easy to go to bed	No	Yes	No	No	Yes	Yes	No	Yes	No	Yes
	1.4 Blanket, bed sheet and pillow case are clean	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Table 5 Pre and post of 5S implementation outcome in five case studies (continued)

Task	Detail	House 1		House 2		House 3		House 4		House 5	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
2	Bathroom/toilet										
	2.1 Organise the items placed along the corridor to the bathroom	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
	2.2 Have clear schedule of cleaning	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes
	2.3 Clean, odourless, dry and unstained or undamaged floor	No	Yes	Yes	yes	Yes	Yes	Yes	Yes	No	Yes
	2.4 Equipment in ready-to-use condition	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3	Kitchen/eating area										
	3.1 Clean and dry floor, free from food waste	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes
	3.2 All appliances are in clean, hygienic condition	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes
	3.3 Adequate lighting, kitchen accessories not in a state of disrepair	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
	3.4 Fuel gas cylinders stored in a safe place, regularly checked	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
4	Floors/connecting area/storage										
	4.1 Items neatly stored inside cabinets	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	No
	4.2 Items labelled and categorised. Warning signs used for fall risk areas	No	Yes	No	Yes	No	No	No	No	No	Yes
	4.3 All areas are clean with no dust, unobstructed walk ways	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes
	4.4 Have clear schedule of cleaning	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Table 5 Pre and post of 5S implementation outcome in five case studies (continued)

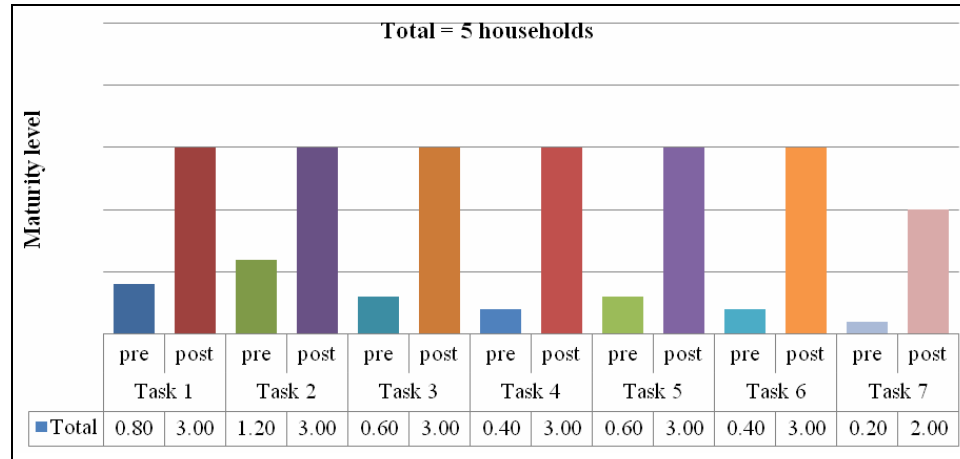
Task	Detail	House 1		House 2		House 3		House 4		House 5	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
5	Living area										
	5.1 Location of seat comfortable and convenient to use	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes
	5.2 Cleanness and neatness of furniture	Yes	Yes	No	No	Yes	Yes	No	Yes	No	Yes
	5.3 No damaged furniture remaining in area	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
	5.4 Items in this area are well organised	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
6	Laundry area										
	6.1 Location of this area comfortable and convenient to use	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
	6.2 Clean and dry floor	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes
	6.3 All appliance and equipment in ready-to-use condition	Yes	Yes	No	Yes	No	Yes	No	Yes	No	Yes
	6.4 Items labelled and categorised	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Through 5S audit, it enabled each house to identify the potential level of quality improvement and at the same time could analyse their ability and weakness of each task of elderly lifestyles. After finishing this implementation, reevaluation was done by experts to check an outcome of these activities as shown in Table 5.

The result from Table 5 indicates that the 5S implementation at 5 case studies in six areas can improve unnecessary items in the houses. Based on the result, only Home 1 could improve all of six tasks whereas other homes needed to improve an infrastructure of their houses such as relocation and buy new cabinets for storage items.

Figure 5 indicates an increase in the process activity tasks of maturity level in the ELTM model by comparing the level before and after the implementation of 5S activity in pre and post. Task 1 to task 6 can improve from range of the average level 0.40–1.20 to level 3.00. In level 3, each task of elderly life styles had continuous improvement by way of having the risk assessment of the cluttered home environment for goal achievement with using a PDCA of implementing 5S. That means this activity can enhance the process improvements to manage unnecessary household items for more maturity. However, the maturity level is not completely up to level 5. It still needs to improve the development process by increasing the maturity level up to level 5. In task 7 (quality assurance), it was increased to level 2. It is the audit quality process of 5S implementation to manage this task process. With an aim to improve quality management for more maturity of quality assurance, it needs to develop an external audit to evaluate the quality outcome and establish a benchmarking system.

Figure 5 The task process maturity level of the elderly household in Sri Bua Ngern Village (see online version for colours)



5 Discussion

In Thailand, rapid demographic transition is moving towards an ageing society (Prasartkul, 2013). The healthy living conditions of the elderly homes should support an active ageing, safe and independent in the long term. It is a preventative strategy to promote quality of life and reduce healthcare cost. Each year, elders fall at home are a cause of serious injury, disability and death (National Center for Injury Prevention and Control, 2014). Falls are often due to hazards of housing environment. Home environment should facilitate the elderly to perform their daily activities safely and independently.

The study aimed to present the ELTM model on elderly's lifestyle for management of the cluttered home which cause risk for falling in the elderly. This model is composed of the process task of elderly's lifestyle and a maturity level assessment of their management of the cluttered process task. The process reference models are the well-concept in the business world (Al-Khiaty and Ahmed, 2013) and help accomplish the management of risk and risk prevention in software engineering using quality and performance measures throughout all processes (Miler, 2005). It drives greater value and benefits as similar way in risk management in the housing environment context. The value is an integrated set of methods for assessing for increasing quality and productivity as a new solution for continuous improvement.

The ELTM model in provide a framework for direct improvement actions and can be evaluated by using risk assessment method of maturity level of the seven tasks. It is a system of more efficient home environment management for ageing society. The tasks of elderly lifestyle are according to the study of Lök and Akin (2013) report that high numbers of problems were in bathroom/restroom, kitchen and bedroom. In general, process reference model is used to contribute the strategic objectives and the management of quality in order to gain competitive advantage in business (Al-Khiaty and Ahmed, 2013; Estampe, 2013; Reicher et al., 2013). These provide a conceptual framework for managing the process of system systematically, deriving improvement actions from

customer expectations and strategic decisions for industry sector. Thus, the Task process reference model on elderly's lifestyle is built based on deep in housing of the elderly in community contexts. Aiming at improving the elderly life style performance is good strategy through the application of process reference model from industry world to community world.

The ELTM model enables to identify the process capability and based on the resulted maturity level assessment leading to quality improvement. It can expect an enhancement of the process by identifying this process strength, weakness and risk and preventing. Task of activity of elderly in the house need to evaluate its capabilities and limitations is be able to improve into more maturity level from level one to level five. This process assessment model under the application of the CMM allows the elderly residents to evaluate its current situation of process performance. Assessment of performance is a virtual evidence to analyse the weakness for determining what areas or activities are the weak points and need to be addressed. The CMM allows an organisation to evaluate its software development processes (CMMI Product Team, 2010). In software product quality, the maturity models are used in assessing the quality of software products to achieve the next level of maturity for continuous improvement (Al-Qutaish, 2011). Having known the current maturity level helps the elderly residents understand the strong or weak point of their environment for improving to reach the next higher level.

In the routine work to evaluation of a home environment is a system of care under home healthcare service provided by occupational therapists, physical therapists, speech language pathologists, home health aides, nurses and medical social workers (Carter et al., 1997; Cumming et al., 2001; Lök and Akin, 2013). Fall-risk screening test is analysed a predictor of hazard to improve function and live with greater independence (Tromp et al., 2001). Thus, interventions from various service providers to promote safety that patients will sometimes choose to act in ways that are inconsistent and non-systematic may not result in desired outcomes. This proposing of process reference is a deploying new strategy relating to improve which basically concerns of their own elderly performance to manage the cluttered house in process areas. The healthcare professional should be take role as external auditor to monitor the elderly performance for sustainable.

A key finding of low maturity level (average of all tasks in 0.37) means that immature the elderly lifestyle task with low quality and fails sustainable results. The maturity level in the elderly risky lifestyle task is an increase by using 5S practice as the solution. According to Ab Rahman et al. (2010) and Kumar and Kumar (2012) revealed that 5S as an effective practice that can improve housekeeping, environmental performance, health and safety standards of environment. This task process reference model on elderly's lifestyle can enhance the safety management in the elderly as internal audit. Thus, the elderly evaluate their own ability of cluttered home management in each lifestyle Task. This is lead to improve more maturity. After establishing the critical processes for improvements, specific improvement actions must be defined. In the future, external audit from third party should be developed as a process of continuously measuring system which will help the elderly take action to improve its performance. However, it should be noted that the processes of elderly lifestyle just proposed can also be used to devise a system of performance measures.

6 Conclusions

In this paper proposed the ELTM model on elderly's lifestyle and risk assessment method for cluttered home of the elderly in northern Thailand. The value of these results is for deploying strategy related to continuous improvement actions according to maturity level. The findings make several contributions.

This ELTM model was developed to provide a framework for directing improved action in managing clutter according to the seven tasks in the basic lifestyle of the elderly. Evaluation scales of maturity level were used to investigate the process for tasks in the elderly's lifestyle and present an opportunity for the elderly to measure and improve their action in cluttered home management. The audit process by 5S implementation (including internal or external audit) is a mechanism that supports the maturity in the ELTM model. The effective practice of 5S implementation can enhance the management of clutter and increases the maturity level for the process of tasks in the elderly's lifestyle.

Implementation of the ELTM model has helped to map out a framework for the elderly to manage environmental hazards caused by clutter in their home; and using the risk assessment method of maturity level leads to improvements and direct action in eliminating the risk of falling. This action supports Thailand's ageing society.

The limitation of this research is that it does not cover all Thai community contexts. The process reference analysis is conducted in context of the real community of the elderly in northern Thailand. It should provide a proven solution that is suitable for the Thai community as a whole for future research.

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