An Improved Documentation of User’s Requirement for E-Service Systems Using Service Responsibility Table

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Abstract— Work System Approach was introduced as a method to help business professionals to analyze systems to their level of understanding regardless of whether IT is involved. The WSA generated series of concepts, such as the work system principles, work system method, work system framework e.t.c. The work system framework was later improved to incorporate activities and responsibilities of both service provider and customer due to the wide agreement that service tends to be co-produced in service delivery, which led to the introduction of service value chain framework. Service Responsibility Table is a lightweight analysis tool developed based on the concept of service value chain framework to help in eliciting and documenting user’s requirements for e-service systems. This research used WSM and SRT in eliciting and documenting user’s requirements for Post Graduate Student Academic Activity System in UTM. The created SRT was evaluated by the selected members of Post Graduate Student Society (PGSS) and SPS staff using 5-points Likert scale measurement in which an average mean of 4 and above and a standard deviation of 0 was obtained from the findings, indicating that most responses were centered on the mean. This shows that respondents rated SRT high in usability and suggested that SRT can be used to improve the documentation of users’ requirements for e-service systems. The paper illustrated how the WSM and SRT can be used to analyse enterprise systems. The paper further proposed heuristic approach for transforming SRT to UML state chart diagram.

Keywords – object oriented analysis and design; unified modeling language; work system method; work system snapshot; service responsibility table

1. INTRODUCTION

In recent years, object-oriented analysis and design (OOAD) is widely accepted as the standard method for analyzing systems, which led to the consolidation of the object oriented approaches to UML [1]. As a tool used in OOAD, UML uses technical terms and notations to describe and represent business processes which affects its comprehension and affects communication between business and IT professionals [2-4]. The difficulty in communication between business oriented and IT oriented world views has made requirements determination a difficult and error prone process. Therefore OOAD and the standard tool used in OOAD (UML) are considered as a method and tool for IT professionals because they focuses on IT views and artifacts that IT professionals need to produce software rather than identifying and improving the business processes [5].

Interaction and collaboration between business and IT professionals should be organized around concept that the business professionals can understand, to enable them participate and communicate effectively with the IT professionals in requirements determination process [4, 5]. As a result of this, the work system approach was introduced as a method to help business professionals to analyze work systems in business terms for their understanding rather than in the IT professionals’ view [6-8]. The WSA created a number of concepts that are implicitly useful to business professionals, such as the work system principles, work system theory, work system method, work system life cycle model, work system framework and work system snapshot. The WSM is more natural and beneficial to business professionals who care more about their work system, because it emphasizes on the business processes since the focus of managers and business professionals is improving the business processes to perform work effectively rather than the IT artifacts used [5-7].

According to Alter [9], every work system that produces products and services for people other than system participants is a service system, and services are often co-produced by service providers and service customers [8]. In view of this, a critical look at the actions and responsibilities of both service provider and customer will enhance the understanding of service systems. Therefore, Service Responsibility Table was developed to depict the generic activities and responsibilities of both service providers and customers since service tends to be co-produced by service producers and service consumers [4, 10]. This paper has shown how the work system snapshot and SRT could be useful in analyzing enterprise systems and proposed a heuristic approach to transform SRT to UML state chart diagram.
The paper proceeds as follows; Section 2 summarizes the problems of using OOAD method in the initial stage of analysis and the effects of the recommended tool (UML) used in OOAD to business professionals. Section 3 explained the WSM and SRT and demonstrates how WSM and SRT can be used to analyse an enterprise system. Section 4 shows the transformation of SRT to UML diagrams and section 5 presents evaluation of SRT.

2. RELATED WORKS

Information requirements determination is a difficult process due to problems associated with OOAD method and the tools (UML) used in the process. OOAD and UML as a tool focus on the IT artifacts such as which activities/processes will use the IT artifacts being built rather how the IT artifacts can improve performance in the current work system. Some of the limitations of UML are summarized as follows:

A. Use of technical terms in UML

UML uses technical terms and notations to represent business processes. When technical terms and notations are used to describe business processes, important business requirements could be lost [2-4]. Business process needs to be represented in business terms for business professionals to understand to enable them participate adequately in system analysis process.

B. Omission of important information

The use of use-case diagrams to represent activities and processes of a work system leads to omission of important information such as non-functional requirements, information used of generated and products/service produced [4, 5].

C. Difficulties in teaching and learning UML

Learning how to build UML diagrams is difficult as it requires a lot of time and techniques due to its semantic issues and large number of construct [11, 12]. Its notations are shown in number of ways which can confuse a novice analyst and can lead to inaccuracy in design [13-16].

D. Complexity of UML

Use of notations and diagrams to represent business process is making UML much complex and difficult for managers and business professionals to understand [3, 17, 18]. This complexity affects its comprehension and affects communication between business and IT professionals, therefore poses challenges to user involvement in the process [18-20].

3. WORK SYSTEM METHOD AND SERVICE RESPONSIBILITY TABLE

A. Work System Framework

The work system framework shows a pictorial representation of the work system in terms of nine elements that forms the fundamental understanding of work system. According to Alter [7-9] the work system framework will improve the analysis of service systems since it has the basis for describing and analyzing IT reliant work system. Figure 1 shows a work system framework.

B. Work System Snapshot

The WSS which originated from WSF can be used to get preliminary understanding of the work system. The WSS summarizes and creates scope of the work system on a single page by identifying the customers, products and services, work practices, participants, information and technologies used in the system. Recker and Alter [21] have discussed how the WSM particularly work system snapshot has helped freshmen and undergraduate students to develop understanding of the relationship between work systems, information systems and IT. Several MBA and EMBA students have produced work system snapshot when analyzing real world systems [22]. The WSS can be used to guide the application of SRT in analyzing systems. Table 1 shows the work system snapshot of Graduate Students Academic Activity System.
C. Service Responsibility Table

Due to the growing concern about service and the importance of co-production in service, the generic activities and responsibilities of both service providers and customers are incorporated into the WSA, which led to the development of service value chain framework (See Figure 2) [8]. Service value chain framework will improve the understanding of service systems during analysis because it accommodates series of assumptions and issues related to service[9]. SRT is a lightweight analysis tool which was developed based on the concept of service value chain framework with two columns to accommodate the activities and responsibilities of both service provider and service customer due to the broad observation that service tend to be co-produce [8, 9]. The format of SRT is flexible and allows easy re-use of the columns to create additional columns for any type of topic that could be useful for the system in analysis [4, 23]. An empirical usage of SRT by MBA and EMBA students has suggested that SRT could be potentially useful in analyzing service systems [4].

Enterprise systems are work systems that support the business processes, information flows and reporting in complex organizations. According to Alter [9] “A work system is a system in which human participants and/or machines perform work using information, technology and other resources to produce products and/or services for internal or external customers” and a work system is considered a service system. Due to the nature of work systems such as production of products and services for internal/external customers and co-production of service by service producer and customer, it is vital to use a method that emphasizes on the work system and how the work system can be improved rather than the technologies used and a tool that accommodate the co-production of service in analyzing service systems. Therefore, the WSM and SRT can be used to analyse enterprise systems effectively.

### TABLE 1: Work system snapshot of Graduate Students Academic Activity System

<table>
<thead>
<tr>
<th>Customers</th>
<th>Products and Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>• PGSS</td>
<td>• Approval of PGSS activity</td>
</tr>
<tr>
<td>• Deputy Dean of Faculty</td>
<td></td>
</tr>
<tr>
<td>• Deputy Dean of SPS</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processes and Activities</th>
<th>Products and Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>• PGSS identify activity</td>
<td>• Ass. Reg. send to Deputy Dean of SPS</td>
</tr>
<tr>
<td>• PGSS login to system</td>
<td>• Deputy Dean SPS makes approval decision with Ass. Reg.</td>
</tr>
<tr>
<td>• PGSS submit request for activity</td>
<td>• Deputy Dean SPS makes approval</td>
</tr>
<tr>
<td>• Deputy Dean of Faculty receives PGSS request</td>
<td>• Deputy Dean SPS produce approval document</td>
</tr>
<tr>
<td>• Deputy Dean of Faculty process request and sent to Ass. Reg.</td>
<td>with budget provision &amp; send to Deputy Dean of Faculty</td>
</tr>
<tr>
<td>• Ass. Reg. receives request</td>
<td></td>
</tr>
</tbody>
</table>
This research used Post Graduate Students Academic Activity System in UTM to demonstrate how SRT can be useful in analyzing enterprise systems. This system is used in UTM to organize and co-ordinate academic activities by post graduate students from various faculties of the university. Table 2 shows the SRT for Graduate Academic Activity System.

TABLE 2: Service Responsibility Table of GSAAS from work system snapshot

<table>
<thead>
<tr>
<th>Provider’s Activities and Responsibility</th>
<th>Customer’s Activities and Responsibility</th>
<th>Information used or generated</th>
<th>Triggers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 PGSS</td>
<td>PGSS identify activity</td>
<td>Type of activity</td>
<td>Academic activity</td>
</tr>
<tr>
<td>2 Deputy Dean of Faculty</td>
<td>PGSS login to system</td>
<td>Login credentials</td>
<td>Need for activity</td>
</tr>
<tr>
<td>3 Deputy Dean of Faculty receive PGSS request</td>
<td>PGSS submit request for activity</td>
<td>Requirements for activity, cost implication</td>
<td>Review and approve request</td>
</tr>
<tr>
<td>4 Deputy Dean of Faculty process request and sent to Ass. Reg.</td>
<td>-</td>
<td>Request for activity, covering note by Deputy Dean</td>
<td>Review and approve request</td>
</tr>
<tr>
<td>5 Ass. Reg. receives request</td>
<td></td>
<td>Covering note by Deputy Dean</td>
<td>Request for approval</td>
</tr>
<tr>
<td>6 Ass. Reg. add comment and send to clerk</td>
<td>-</td>
<td>Covering note by Deputy Dean</td>
<td>Process request</td>
</tr>
<tr>
<td>7 Clerk prepare approval form based on comment</td>
<td>-</td>
<td>Comment by Ass. Reg., approval form</td>
<td>Approval form</td>
</tr>
<tr>
<td>8 Clerk sends approval form to Ass. Reg.</td>
<td>-</td>
<td>Use comments, approval form</td>
<td>Approval form</td>
</tr>
<tr>
<td>9 Ass. Reg. send request to Deputy Dean of SPS</td>
<td>-</td>
<td>Activity request, note from Deputy Dean, approval form</td>
<td>Request for approval</td>
</tr>
<tr>
<td>10 Deputy Dean SPS makes approval decision with Ass. Reg.</td>
<td>-</td>
<td>Use requirements for activity and cost implication, budget</td>
<td>Request for approval</td>
</tr>
<tr>
<td>11 Deputy Dean SPS makes approval</td>
<td>-</td>
<td>Activity report, approval/rejection</td>
<td>Funds available, funds not available</td>
</tr>
<tr>
<td>12 Deputy Dean SPS produce approval document with approved budget and send to Deputy Dean</td>
<td>-</td>
<td>Decision on request, budget for activity</td>
<td>To give approval and inform of approve budget</td>
</tr>
</tbody>
</table>
4. TRANSFORMING SRT TO UML DIAGRAM

SRT is developed to complement UML in the early stage of system analysis. After identifying and documenting requirements of the intended system with SRT, the created SRT will be transformed to UML diagrams for further analysis and implementation. Currently, there are two approaches to transforming SRT to use case and class diagrams, this research has proposed a heuristic approach to transform SRT to state chart diagram being one of the important diagrams created in systems analysis to aid the understanding of systems.

A. Transforming SRT Use case diagram

The following heuristics have been proposed by Alter [10] to guide the transformation of SRT to use case diagram:

i. Identify the various types of service providers and customers in an SRT and consider them as actors in a use case diagram.

ii. Identify the various activities and responsibilities associated with each type of service provider and customer. These activities and responsibilities can be regarded as candidates for use cases in a use case diagram.

iii. Based on the expected functionalities, decide which use cases should be included in the use case diagram.

iv. Link actors with corresponding use cases; show “extends” or “includes” relationships among use cases based on the SRT.

Based on this heuristics we have created use case diagram from the SRT in Table 2.

i. Post Graduate Student Society, Deputy Dean of Faculty, Assistant Registrar, SPS clerk and Deputy Dean of SPS are identified from the SRT in table 1 and we regarded them as actors for the use case diagram.

ii. We summarized the primary activities and responsibilities in the SRT and treated them as use case candidates in the use case diagram.

a. PGSS submit request for activity
b. Deputy Dean of Faculty process request and send to Ass. Registrar
c. Assistant Registrar receives request and forward to clerk
d. Clerk prepare approval form
e. Assistant Reg. send request to Deputy Dean SPS
f. Deputy Dean SPS make approval
g. Deputy Dean SPS produce approval with budget provision
h. PGSS submit activity report to Deputy Dean Faculty
i. Deputy Dean faculty send to Deputy Dean SPS
j. Deputy Dean SPS send for payment

iii. We have exclude decision on application since it is done outside the system, based on this we have identified seven use cases from the SRT.

iv. We linked the identified use cases with actors based on the identified description in the SRT.

The use case diagram crated is shown in Figure 3.
B. Transforming SRT to Class diagram

The following heuristics has been proposed by Alter [10] to be used in transforming SRTs to class diagram:

i. Identify all the objects mentioned in the three columns of SRT and determine the objects about which the software system will track or maintain information. These will be considered as classes.

ii. Decide the names of classes and the relationships among them.

iii. Identify the attributes for each class using the contents in the third column of the SRT.

iv. Fill in missing classes, attributes, and relationships by further analysis.

Following this heuristics we generate class from the SRT in table 1 through the following steps:

i. The objects in the three columns SRT which the system will record their information are, PGSS, Deputy Dean Faculty, Assistant Registrar, clerk SPS, Deputy Dean SPS, activity, note on activity and faculties. These are considered candidates for the classes.

ii. Using the descriptions in the SRT, the individual classes are connected through associations. For instance, assistant registrar is associated with activity, while PGSS is associated with activity and part of faculty, thus an aggregation relationship. Also assistant registrar is associated Deputy Dean of faculties and Deputy Dean SPS.

iii. We have used the content in the third column in SRT to fill in the attributes of the classes. For instance, activity has attributes consisting of type of activity, requirements for activity, venue and date.

iv. The classes that are type of person will be a subclass of the person class. There is a generalization relationship between person and its subclasses.
FIGURE 4: Class diagram from SRT in Table 2

C. Transforming SRT to State chart diagram

State chart diagram is used to show the different states through which a single object passes through its life in response to events. It can help in understanding the dynamic aspect of a class and how it evolves over time. Because state chart diagram is considered as one of the important diagrams used to gain the understanding of systems, it is significant to provide an approach to transform the created SRT to state chart diagram. This research proposed a heuristic approach for transforming SRT to state chart diagram using the additional column created for triggers.

i. First step is to identify the various states that an object will have over its lifetime from activity and responsibility columns of the SRT created. Identifying the initial and final states of an object. Also we must identify the stable states of an object.

ii. The second step is to determine the sequence of states that an object passes through during its lifetime. This can be found in activity and responsibility columns of the SRT. Using this sequence, we place the states onto the state chart in a left-to-right order.

iii. The third step is to identify the events and actions associated with the transitions between different states of the object. This can be found from triggers column in the SRT.

iv. Finally, draw state chart diagram and validate the states of the object.

Following this heuristics we created state chart diagram from the SRT in table 2 through the following steps:

i. The states undergone by the selected class (Activity) are activity request, request sent, review request, activity request forwarded, processing, approved, organized activity and report activity. These are considered as states for the state chart diagram.

ii. The states are arranged in sequence as shown above.

iii. The events that are associate with the transition in states of the object as identified in triggers column are request for organizing activity, submit request, request sent for review, sent for approval, request for approval, funds available, approved budget, send activity report for payment and funds not available, not approved, activity closed.

Figure 5 show the state chart diagram created.
Figure 5 has shown the different states of the activity and the transition from various states. As stated above the column for triggers in the Table 2 is used to identify actions associated with the transitions and it is used in creating the state chart diagram. The process usually starts with an activity request from PGSS. An activity request can be rejected from the beginning if it is not written properly. An activity can also be rejected if there is lack of funds and it will be closed while if funds are available, the activity will approved, organized, report the activity and then closed.

5. EVALUATION OF SRT

Evaluation was conducted through a survey of selected users. Survey is defined as “a means of gathering information about the characteristics, actions, or opinions of a large group of people, referred to as a population” [24]. Descriptive analysis was conducted on the survey findings from the selected population.

A. Survey sample and instrument

The purpose of this survey is to investigate the usability (ease of use and usefulness) of SRT from the users. A sample of 32 respondents was purposively selected for the study, which were selected from PGSS of various faculties and SPS because they are mainly involved in the process. Questionnaire consisting of 16 questions which were adapted from the widely used instrument that has been validated by several empirical studies to measure ease of use of new technology by Davis [25] was used as a means of data collection for the survey.

B. Result and Discussion

The questionnaire comprised of closed ended questions using 5-points Likert scale measurement, 1 => Strongly disagree, 2 => Disagree, 3 => Neutral, 4 => Agree and 5 => Strongly agree. An average mean of 4 and above means respondents rated SRT easy to use and useful in eliciting and documenting users’ requirements. Standard deviation is also used to show variations in responses. SD of 0 is obtained when all the responses to the questions are the same. However low SD means most responses are centered on the mean and high SD means there are variations in the responses.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) I find it easy to identify requirements using SRTs</td>
<td>4.38</td>
<td>.492</td>
</tr>
<tr>
<td>2) I found SRTs to be flexible in identifying requirements in-depth</td>
<td>4.47</td>
<td>.507</td>
</tr>
</tbody>
</table>
Table 3 indicates that the mean score for ease of use is high above four showing that users perceived SRT high in usability. As indicated in the Table the standard deviation (SD) for scale of ease of use is low around the mean score. This shows that there is no variation in the responses, except for indicator number 5. In this case there is variation in respondents’ answers for this indicator. Some respondents agreed while others disagreed that SRT can be used without any assistance from IT professional. However the mean is above four indicating that most respondents agreed that they can use SRT without any assistance from professionals.

### TABLE 4: Descriptive statistics for scale of usefulness of SRT

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) SRTs is very useful to business professionals in identify systems requirements</td>
<td>4.69</td>
<td>.471</td>
</tr>
<tr>
<td>2) Using SRTs give me great confident to participating in system analysis</td>
<td>4.31</td>
<td>.896</td>
</tr>
<tr>
<td>3) SRTs can improve my communication with system analyst</td>
<td>4.28</td>
<td>.457</td>
</tr>
<tr>
<td>4) Using SRTs saves me time in defining requirements</td>
<td>4.22</td>
<td>.420</td>
</tr>
<tr>
<td>5) SRTs can encourage deep reflection about business routine</td>
<td>4.69</td>
<td>.535</td>
</tr>
<tr>
<td>6) SRT has explained all the business process of application for activity in GSAAS clearly</td>
<td>4.75</td>
<td>.440</td>
</tr>
<tr>
<td>7) Overall, I believe SRT will improve the documentation of users requirements for e-service systems</td>
<td>4.38</td>
<td>.492</td>
</tr>
</tbody>
</table>

Table 4 indicates that the mean score for usefulness is high, showing that users have perceived SRT high in usefulness. As shown in the table the standard deviation (SD) is around the mean score. This indicates that there is no variation in the responses. All respondents have perceived SRT high in usefulness. Findings from the survey indicated that users perceived SRT as easy to use and useful in analyzing e-service systems, which confirms that SRT can be used to improve the documentation of users’ requirements for e-service systems.

### 6. CONCLUSION

This paper demonstrates how SRT can be used to analyze Enterprise Systems and bridging the communication obstacles between business and IT professionals by representing user’s requirements for IT-reliant work systems in business terms rather than IT professional’s formalism. The advantage of using WSM and SRT is to improve the understanding of work systems and collaboration with managers and business professional by empowering them to participate in the process and be able validate the accuracy requirements. The features of SRT will improve the elicitation and documentation of user’s requirements for e-service systems. The paper presents how SRT can be transformed to UML state chart diagram using heuristic approach by using the additional column created for triggers to identify events and actions associated with the transitions between different states of the object.

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