

WCETR 2011

## The new formal specification framework of individual emergency, response and preparedness

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### Abstract

Competence is a very important characteristic to all area of activity, especially in an emergency situation. This is because people must react according to what supposed to do. In particular, if an individual lacking competence in the job or life, the person may take wrong action and make more loss in the area of work or situation such loss of life, injured, and others. This paper presents a new formal specification framework of individual Emergency, Response and Preparedness (ERP). A chemical company in Pahang, Malaysia has been selected as a case study to model the framework of emergency, response and preparedness. We design the framework of ERP according to the company's competency by considering three elements which are the skill, knowledge and attitude. Furthermore, this framework results the specification becomes clear, sharp, precise and non-multi-interpretation.

*Keywords:* Educational software, dental measurement system, Image processing techniques, calibration and measurement.

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### 1. Introduction

A formal specification of the system developed for inconsistency. This technique is effective in discovering clearer, errors and omissions [1]. The argument for the use of formal specification forces a detail analysis of the specification of requirement. It demonstrates the development program meets its specification so implementation errors do not compromise dependability. In this paper we used Z notation to show the formal specification of the Emergency Response and Preparedness (ERP). According to ISO 14000 [1], the organization is required to establish procedures for identifying the potential for and responding to emergency situations and accidents that can have an impact on the environment. It because many environmental impacts of an emergency or accident situation are minor in nature, it appears that all potential emergency or accident situations need to be identified before a resolve of environmental impacts can be made. An organization that attempts to identify potential emergency or accident situations based on a review of its environmental aspects would likely miss the environmental impact potential of, say, an automobile accident. Staff in any critical have to know and should be prepare to act if hazard occur. So, same with the chemical plant the emergency response and preparation for situation consider as very critical part. In this paper we choose one chemical plant to know the activities of the ERP. So, in developing software to the ERP we need to consider this critical area to make sure our requirement is complete according to the requirement needed.

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Formal specification is the detail explanation about the area that we study. Through this formal specification, we can help to clear all the relevant specification, thus unambiguous event can also be comprehensible. This formal specification uses Z notation to describe the requirement.

In this paper, we proposed a formal specification using Z notation from informal requirements. The illustration is used to make it understand by an example Assessment for Emergency Response and Preparedness in the area of safety and health in on company which chemical plant. Depending to the assessment model we derive the logic statement. Next, we set up a basic type of the system and initial state of the system. After that we create a Venn diagram to show the relation between basic types that involve in the system. Finally, from the Venn diagram we convert into the state schema.

This paper is structured as follows: in Section 2 we discuss related work of this research. Section 3 describes the Venn diagram. Section 4 presents the result in Emergency Response and Preparedness. This section explains how to do individual assessment that relate on the skill, knowledge and attitude. Finally, we conclude the paper in Section 5.

## 2. Research Background

In this section, we present the concepts of ERP, and Z notation.

### 2.1. Emergency Response and Preparedness (ERP)

The objectives of emergency respond training in the company are to understand what are the properties and behavior of different emergencies and how they can cause damages, design effective Response Strategies, understand and apply good Response Techniques, Learn about Emergency Response Equipment, and be able to carry out an effective Emergency Responses when an emergency occur. The training duration is five hours during off day and the location is Fire Department training room.

The module included first, the Fire Awareness & Prevention is to identify situation which could lead to fires or other emergencies, second, Smoke Alarm System to explain to the individual about the location happened, operation and the limitation of alarm system., third, Sprinkler Systems. Forth is Evacuation Procedures (Theory) individual to identify emergencies according to the emergency alerts and signals given., fifth is Evacuation Procedures (Practical) implementation to the appropriate changes to emergency procedures in an emergency situation, sixth is Portable Fire Extinguishers & Fire Blankets to identify the type of emergency control equipment and the limitations, location of emergency equipment, assess emergency situation and the effectiveness of first attack action. and lastly is Other Fire Emergencies can demonstrate an understanding of other fire emergencies that could occur. It also identifies considerations for bush fire prevention around the emergency area and addition equipment required if the area is rural areas.

. This module delivers for both theory and practical. To access the knowledge transfer is effective the quiz and practical given.

Besides the respond and preparedness staffs also need to have skill and knowledge in emergency facing. The skill and knowledge required at completion of the training. The ERT should have the following knowledge and skills: Fire awareness & prevention, smoke alarm system, sprinkler system, theory of evacuation procedures, and practical of evacuation procedures, Portable Fire Extinguishers & Fire Blankets, and Other Fire Emergencies.

### 2.2. Z notation

The Z systems are modelled using sets and relations between sets. This method is an approach for the industrial development of highly dependable software. It has been successfully used in the development of complex real-life application be it constructs specification in software specification. The use of mathematical statement will make very hard to understand the process of the system. Also, set and relation between sets in mathematic we can show using the Venn diagram. The formal description is easy to chunks that are distinguished from association text using graphical highlighting called schema. It used to introduce state variables, define constraints and operation on the state [6]. In Z notation the specification shows in diagram approach. The Z notation is quite similar with the B

notation. In this report will used Z/Eve notation to produce the formal specification. The Z notation is also similar with other programming language because there is syntax for the statement that we want to form.

### 3. Related work

According Yilmaz Alan [3] said that by the formal specification of concepts, knowledge can be structured in ontologies in a machine processible manner. The intentional content of a concept is explained on the one hand. On the other hand the extent of a concept is given by its instantiation. By the formalization of the intentional as well as the extensional context of concepts an interpersonal agreement on their semantics can be achieved. This shared understanding is needed in every kind of communication.

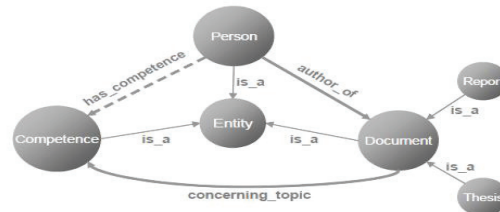


Fig 1: Ontologies

The axiomatic part of an ontology is consists of inference rules and integrity rules. By the specification of inference rules formerly implicit knowledge can be clarified. This ability to clarify implicit knowledge is already known from logical programming. An example demonstrates the use of inference rules in ontologies:

$$\begin{aligned}
 & \text{FORALL } X, Y, Z \\
 & X[\text{has\_competence} \rightarrow Z] \leftarrow \\
 & (X:\text{person}[\text{author\_of} \rightarrow Y] \text{ AND} \\
 & Y:\text{report}[\text{concerning\_topic} \rightarrow Z])
 \end{aligned}$$

The specification of ontologies used by Yilmaz et al is done using a formal language called F-logic. The F-logic used for the implementation of knowledge spaces. In order to maintain interoperability with other works, structural parts of the ontologies have also been embedded in his research.

The security requirement specification framework for the formal Network Access Control – Policy model consists of the following (1) Formal Model of Network Security Policy, (2) Formal Specification of Security functional components, (3) Verification of formal model of Network Security policy. For Internal threat protection in network computing environments, the network security policy model presently focus only on two major families of Security functional policies(SFPs): Access Control SFPs and Information Flow Control SFPs. Access control SFPs base their policy decisions on attributes of the users, resources, subjects, and objects. These attributes are used in the set of rules that govern operations that subjects may perform on objects. Information Flow Control SFPs base their policy decisions on the attributes of the subjects and information within the scope of control and the set of rules that govern the operations by subjects on information. The formal model of network security policy is divided into three models for structural representation. There are data model, state machine model, and policy model. Formal specification of security functional components is provided for recognizing consistency between network security policy model and security function specifications. Verification of normal model is for ensuring consistency and completeness of the network security policy model.

Eelco Herder et al [4] define Competence Development Programmes (CDPs) as formal, non-formal, or informal collections of learning activities and units of learning, which are used to build competence in a certain discipline or job. The learning activities and units of learning are relatively independent from each other – as compared to a unit of learning, which is a tight integration of learning activities. Depending on the competencies to be built, these programmes can be small or quite extensive. We envisage that CDPs can be greatly facilitated by so-called learning networks – people, institutions, learning objects and autonomous agents, which are connected by ICT networks. Within these networks, learning units can be created and shared in a distributed, self-organized manner. In a sufficiently large learning network, the various bodies of knowledge existing in the group allow for the creation of learning programmes that fit an individual.

## 4. Proposed Framework

### 4.1. The Model of the Individual Assessment Process

The model of individual ERP is shown in Figure 2. Individual should know their job in the area of working and they need to follow the task given which is according to the Set Task Standard. In this Set Task Standard, they fulfill the three elements which are knowledge that needed skill in that area and attitude. The three elements will be assessed if the situation still not achieve the standard set, they should be retrained until achieve the standard.

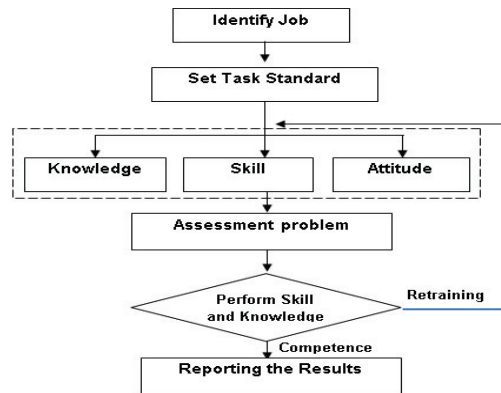


Fig 2: Model Flow for Competency

### 4.2. Formal Specification

In formal specification need to assign set involved in the competency. The main elements in competency are skill, knowledge and attitude. All these three elements should get from training until competence. So, the set is [Competence]. The state diagram for ERP is like the Fig 3 and Fig 4 shows the initial state for competency. Operation involve in this competency such as KnowledgeOk, SkillOk, AttitudeOk. Then the error handling for this competency such as NotKnowlegable, NotSkill, NoAttitude. Query for this competency is alreadyKnowlegable, alreadySkill, and AlreadyAttitudeOk. The knowledgeOk in Fig 5.

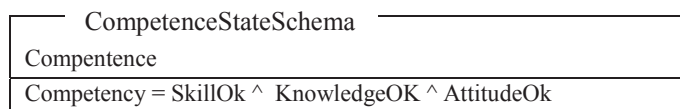


Fig 3: State Schema for Competency

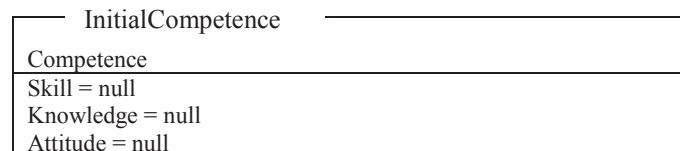


Fig 4: Initial State for Competency

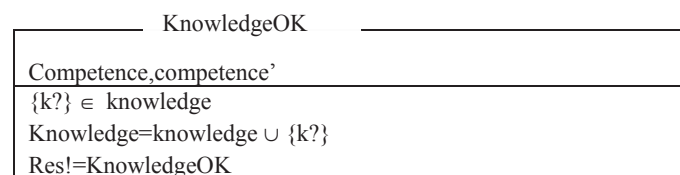


Fig 5: KnowledgeOk

User interface for the operations such as knowledgeable, skillfull and attitude are followed:

$$Knowledgeable = KnowledgeOk \vee Not Knowledgeable \wedge AlreadyKnowledgeable \tag{1}$$

$$Skillfull = skillOk \vee NotSkill \wedge alreadySkill \tag{2}$$

$$Attitude = attitudeOk \vee NoAttitude \wedge AlreadyAttitudeOk \tag{3}$$

The verification is to check whether the individual is competence or know is the individual should fulfill the skillOK, KnowledgeOk and attitudeOk. The schema shows the combination of these elements the individual is competence in the work area.

$$Competence = skillOk \wedge knowledgeOk \wedge attitudeOK \tag{4}$$

The truth table in Table 1 shows the verification of competency of this ERP. So, this competency is valid to show axiomatic of ERP.

Table 1: Competency for Truth Table

S (SkillOk)	K(KnowledgeOK)	A(attitudeOK)	Competency
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

**5. Conclusion**

The key components of Individual Emergency, Responses and Preparedness are formalized in order to be sharp, precise and prevent their multiple interpretations. The schema describing the basic system elements was large due to multiple security constraints of social environment. In our future work our focus is to use symbolic computational environment to produce an animation of the formal specification to further refine the framework.

**Acknowledgment**

This work has been supported by the University Malaysia Pahang under grant RDU 090378.

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