Consideration of Evaluation of Communication using Work Domain Analysis (WDA) in Nuclear Power Plants

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1. Introduction

The nature of work has changed, this corresponding to a trend toward to computerization. In this phase, the role of people began to evolve from one of manual laborer, requiring primarily perception-motor skill, to intellectual worker, thereby requiring more conceptual knowledge and cognitive skills which means system such as nuclear power plant are getting more complicated and complex. Thus, the evolution of work has led to a greater demand for communication, collaboration, problem solving thereby increasing the discretion, and therefore the variability, in worker action. [1] Because of these reasons, traditional approaches, normative method and descriptive method, have not been proper anymore.

Naikar points out that by focusing on constraints, rather than on particular ways of working, it is possible to support workers in adapting their behavior online and in real time in a variety of situation, including unanticipated events. For these complex domain such as communication in nuclear power plant control room, an approach is required that models the conditions framing formative behavior, allowing the examination of emergent, unanticipated, unpredicted actions.[2]

In this study, it could be helpful to introduce the method that is proper to apply in complex and unanticipated like nuclear power plants. Thus, Abstraction Decomposition Space (ADS) which is the tool of Work Domain Analysis(WDA) is presented as an approach that is particularly amenable for this domain. The aim is to address ADS as a beginning of modeling the structure of what need to be analyzed can be used to support the analysis of communication in nuclear power plants. If the model that is made by ADS is correct, quantitative evaluation of communication could be done

2. Abstraction Decomposition Space (ADS)

2.1 Method

WDA is the most commonly used component within Cognitive Work Analysis (CWA) and used to describe the domain in which the activity takes place independent of any goals or activity. The main aim of WDA is to model the constraints that relate to the purposive and physical context in which workers operate. The tool Vicente (1999) recommends for WDA is the Abstraction Decomposition Space (ADS). The ADS is a two dimensional space representing an Abstraction Hierarchy (AH) and a Decomposition Hierarchy (DH). [2]

The relationships between the different levels of abstraction in the ADS are means-ends relations. These relationships, which can be characterized in terms of a how-what-why triad, are illustrated in Figure 1. [3]

	Whole system	subsystem	Component
Functional Purposes			
Value and Priority Measures	D		
Purpose-related Function	A		
Object-related Processes	B,C		
Physical Objects			

Fig. 1. Abstraction Decomposition Space

In the figure1, Purpose-related Function A specifies what is under consideration. Relationships from Purpose-related Function A to the level below, in this case Object-related Processes B and C, indicate the means or how Purpose-related Function A to the level above, in this case Value and Priority Measure D, specifies the ends or why Purpose-related Function A is present in the work system. This how-what-why triad can be applied by starting at any level of abstraction on the ADS.

According to Rasmussen's research, he mentioned that almost all of the cases of problem solving, people have a tendency to behave like a diagonal shape in ADS as shown figure2.[4] that's why contents for good communication can be extracted from the ADS by dealing with ADS inversely. In short, it is possible to know or foresee communication way we anticipate using analyzed

ADS because of the diagonal of the decision making or communication in ADS.

	Whole system	subsystem	Component
Functional Purposes			
Value and Priority Measures			
Purpose-related Function			
Object-related Processes			
Physical Objects			

Fig.2 . The diagonal characteristic of ADS

2.2 Example

Unfortunately, there is no specific ADS in Korean NPP. But ADS including two AH level at the components level have built in NOVA's E1 Acetylene Hydrogenation Reactor [5]. As shown in figure 3, there are so many relations between Object related-Function and Purpose related function. Based on these relations, the contents for communication can be extracted from ADS. For example, in figure 3, since DMDS Flow is directly connected with FV135 which is one-to-one mapping, it is necessary to have proper communication about FV135 when the situation like DMDS flow low or high happens. The other cases are one-to-many or many-to-many mapping. In these cases, contents from team communication can be different from each team. So there must be more possible communication between operators and it could be analyzed and evaluated using modeled ADS. Generally speaking, in any cases, after specific analysis ADS to get the contents for communication, it also could be the basis for how to define good communication and specific activity analysis.

3. Conclusion

As systems are getting complex and complicated in nuclear power plant control room, there need to be another method to model and evaluate communication between operators in control rooms. As a formative approach, ADS is proper to use in these situations because there are too many unanticipated or unpredicted event in nuclear power plants. WDA that is one of the CWA phases and widely used in other domains was used in the team communication. Based on this analysis, we believe that quantitative evaluation of communication could be possible.

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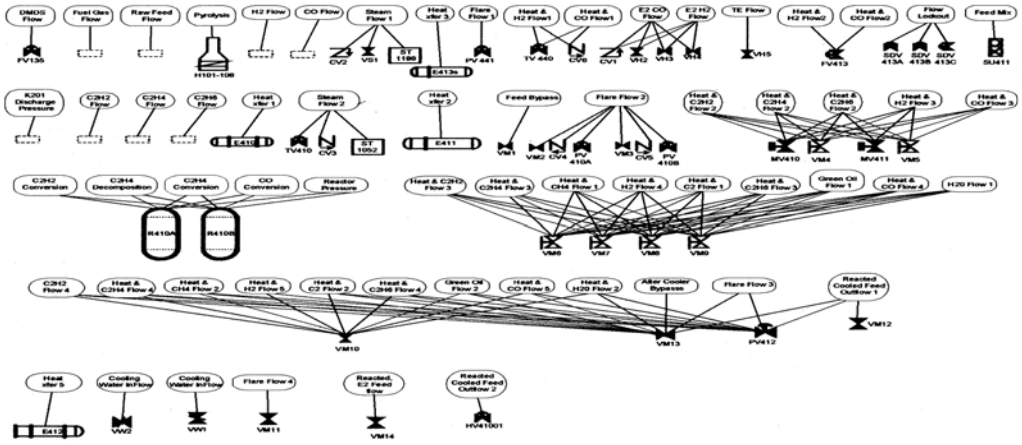

Fig.3.The transition diagram showing the links between Purpose-related Functions and Object-related Functions at the Component level