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Research on Dependable Ionizing Radiation Protection Based on Model i*

Hai Tan[1], Talpur Shahnawaz[2], Qureshi Imran Ali[2], Dan Zhao[1], Renbo Wang[1]
[1]Engineering Research Center of Nuclear Technology Application, Ministry of Education, East China Institute of Technology, Nanchang, China
[2]Mehran University of engineering and Technology Jamshoro, Pakistan
*Corresponding author, e-mail: htan@ecit.edu.cn[*1], mirshan35@gmail.com

Abstract

The software's unreliability mostly attributes to an erroneous analysis on the requirements done at the beginning. In this paper, we apply the tool of i frame requirement modeling and build early requirement model against ionizing radiation. After finding out possible risks and corresponding solutions during the process of modeling analysis, we propose reasoning models against ionizing radiation. The radiation protection system with the above models can figure out the purpose of agents related to radiant source and provide normal service even when the environment software system is being interfered. It can serve the ecological and economical society with stability and development. The model is divided into several sections. Section 1 gives the outline of the dependant software. Section 2 illustrates the i* frame technology. Section 3, 4 and 5 cover the topic of dependant security requirement analysis, SD&SR model on ionizing radiation respectively. Section 6 gives the conclusion.*

Keywords: *i* frame, ionizing radiation protection model, dependant requirements*

1. Introduction

Nowadays control technology based on software has become a major technology in supervising and managing nuclear power stations and non-nuclear energy ionizing radiant matters. It is also helpful in supervising and disposing of radioactive source. In this papert, networked supervising system for radioactive source is proposed and safety requirements for disposing scraped radioactive resource are discussed. This helps in lowering the risks to people's health and promoting the healthy development of utilizing nuclear technology. Thus it is necessary to make use of computer software system to supervise and manage ionizing radiation operation while establishing networked ionizing radiation supervisory system [1] [2]. People make a strategic decision mainly according to the data supplied by the system. But it is not so dependable [3] because it doesn't work the way as people expected for there are various breakdowns and failures caused by the large scale control management system and complexity of logical operation. As is shown in the study, 41 percents of software's unreliability is caused by wrong requirements [4] worked out at the beginning.

Ionizing radiation is so dangerous that it is apt to lead to social panic once it pollutes the environment. It causes harm to public health and disturbs the ecological balance and is difficult to handle and recover the polluted environment. People come to realize the importance of dependable software system because a variety of breakdowns occurs one after another in the computer system and has caused huge losses. American government budgeted a sum of $30 million for highly dependable software and system in 2006 and 2007. National Science Foundation of China started major research plan for the study of dependable software at the end of 2007 and a sum of 15 million RMB had been invested [5]. The dependence of software refers to the dynamic behavior of the software system and the result always meet people's expectation including providing successive service under such interference like operational mistake, environmental influence and even external attacks [3], [5].

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2. Dependable Requirement Model Technology i* Frame Based

I* frame modeling technology [6] [8] is a subject and purpose-oriented requirement methodology. It follows organizational behavior foundation and emphasizes each individual real purpose in the system, which is used as the foundation for constructing dependable software. There are many successful cases for example, i* frame modeling technology is successfully applied in many dependable modeling designs such as Business Modeling design by professor Alistair G. Sutcliffe at the Institute of Science and Technology University of Manchester United Kingdom [9] and Gunter Gans at RWTH Aachen [10]. [11] presents a comparative stuty of the three most widespread i* variants and proposed a generic conceptual model to be used as reference framework of these three variants.

I* frame, a software system stressed to strengthen social control, should build an early require ment model based on environmental subject and purpose and combine specific key operations. We emphasize the true purpose of each Agent which make up the system in terms of organizational behavior and make it as the foundation for constructing dependable software [12] [13] [14].

In i* frame, anything that can sense the change in environment and has influence can be regarded as the agent, so the agents, driven by their own target, have such connotations: knowledge, belief, expectation and intention etc which show subjective consciousness. Based on purposeful participants, the context relation of the information system organization layers are modeled and given formal description. The process of modeling includes identifying participants, establishing dependence and making the final schemes.

3. Analysis of Dependable Requirement Model on Ionizing Radiation Protection i* Based

After establishing ionizing radiation protection monitoring system, old working model would change greatly for both the personnel and the departments. The data and conclusion from the system will be trusted and used to make a policy so it is required that the software work normally under interference condition from social environment i.e. people. Since the interference and expectation in the environment are not from the system, we analyze the situation and get the conclusion that agents in the environment should include active and physical agents, positive and negative roles, misuse and failure, intentional and malicious mischief and so on. The radiant source protectors is likely to shut down the system purposely to avoid being monitored, so we add a function in case the system be shut down abnormally. Added examples of on-line monitoring for mobile radiant source when misused are shown in Figure 1.

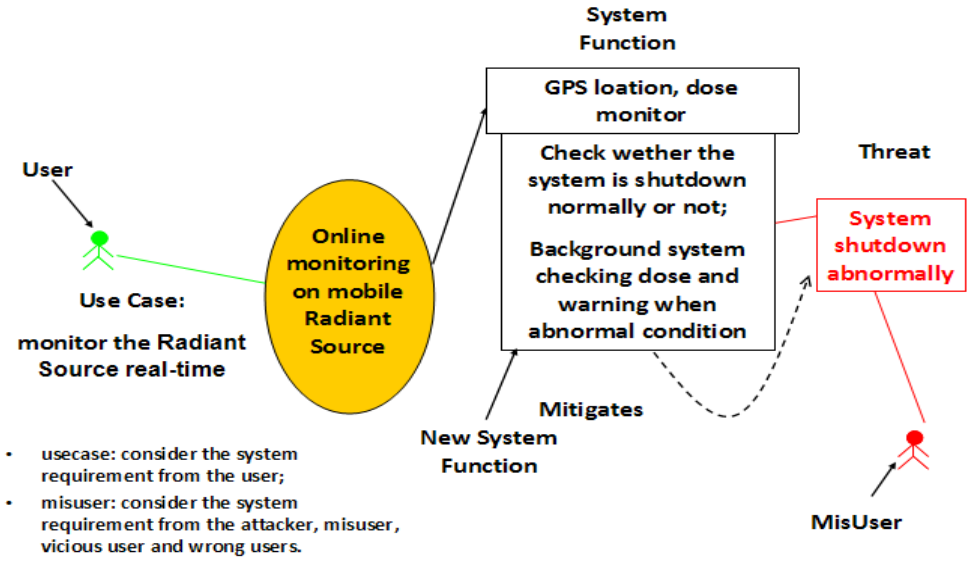

Figure 1. User Case Given Misuser

4. SD&SR Model on Ionizing Radiation Protection

The specific software modules in the system include corporation monitor, communications service, monitoring center, data-processing center, GIS interface module and RFID interface module etc. Ionizing radiation supervisory system consists of equipment agent, personnel agents and software agents. Personnel agents comprises of ionizing radiation, radiation source protector, operator on duty, dispatchers in production, supervisory center staff and so on. Software agents which comprise programs of radiation source automobile vehicle-mounted dose detection, GIS receiving and transmitting, input/output Management and a self contained program for entering and leaving the yard management module which can control its own strategy and operation from the results of environmental monitoring and achieve certain objective. When modeling, we take many factors into account such as every agent's certain degree of independence and autonomy, each agent's different goal and desire, the knowledge to realize the target, the flexibility and adaptability in changing environment and their reactivity and pro-activeness. The corresponding strategic dependency and strategic rationale (SD& SR) model is shown as Figure 2.

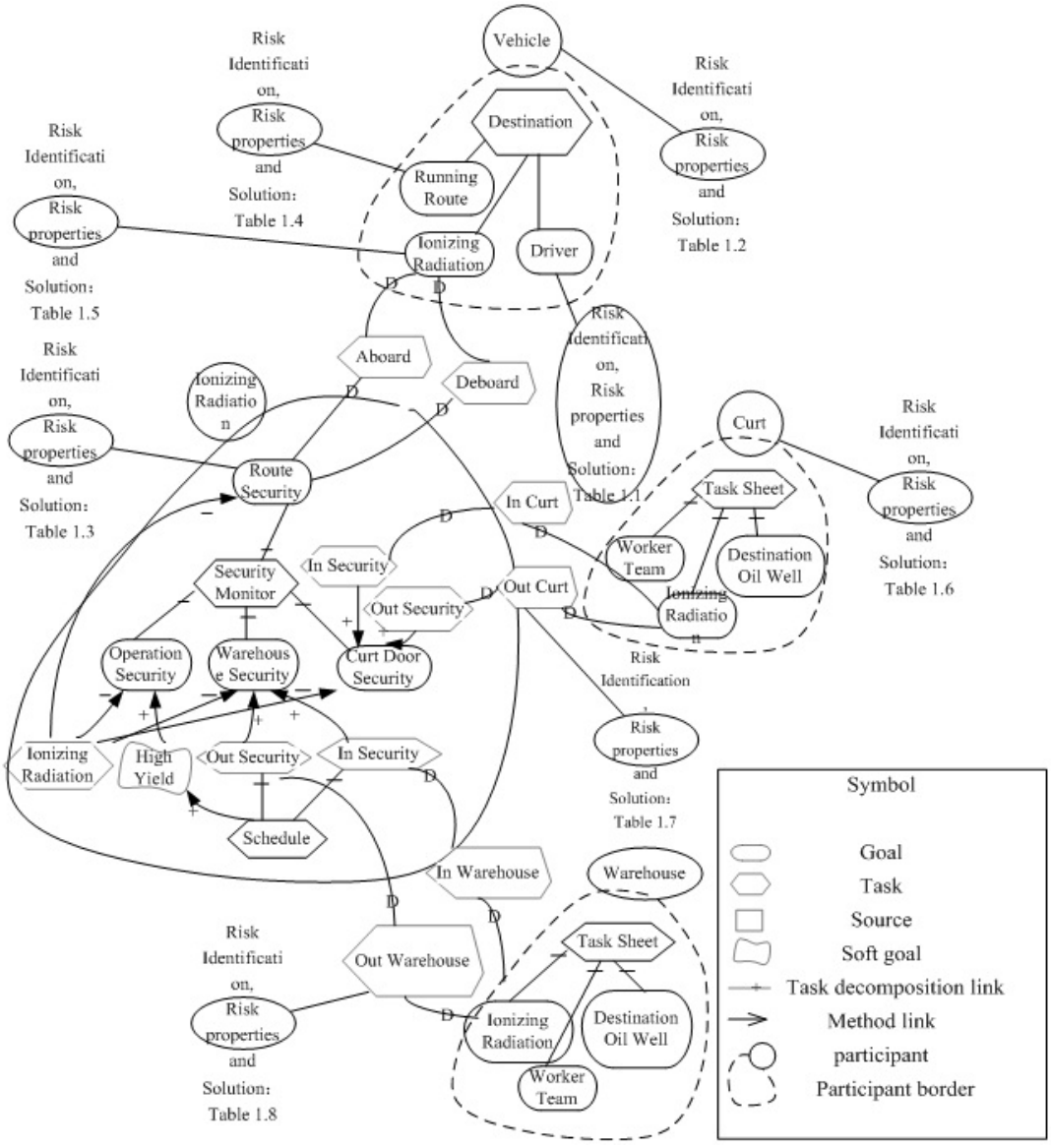

Figure 2. SD & SR Model on Ionizing Radiation Protection

5. Analysis of Potent Risk on Ionizing Radiation Protection

Based on SD&SR model, we build dependable safety requirement model, risk analysis and normal demand analysis which mainly stimulate the system and the major participants in the environment. In the ionizing radiation protection system, the participants are: warehouse keepers, dispatching department, production teams, radiation source protector, safe environmental department etc; software agents are: modules of gates of yard, vehicle-mounted terminal, warehouses, supervisory center, in-out warehouse operation and background data maintenance etc; equipment and instruments are: vehicle-mounted radiation dose meters, hand detecting instruments in the gates of the yard etc. These participants can be further divided into abstract roles, locations, and specific agents and roles, locations and agents are organized as participants' classes of hierarchical structure, abstracted and instantiated. In the process of risk analysis and identifi cation requirement, we suppose every participant were an attacker. Judging from their capacity, we try to find the possibility of usurpation. In such cases, the attackers may usurp their legal resource, ability and social relations into illegal purpose. In table 1, predictable risks during the process of modeling and corresponding measures are listed, which can be used as the foundation of demand analysis design.

Table 1. Risk List of Management Table

No	Risk Identification	Risk Properties	Solution
1	The driver closed the monitor device system on purpose in order to escape monitoring or because of vehicle power supply finished cause the system to shut down.	Vicious or Miss	Equipped with enough power and warning
2	Ionizing radiation's data don't report real-time Due to the GIS blind area.	Miss	Backup Data or send out data in another way
3	Ionization radiation failed to get on the car, fell on the site.	Vicious or Miss	RFID identifies and monitors dose when get on.
4	The driver does not following the planned route; the source car is driven into the city banned sites.	Vicious or Miss	GIS monitors all the way, reports and warns when deviates from normal track
5	Ionization radiation lost on the way	Vicious or Miss	The dose monitoring terminal report data to GIS accept center real-time.
6	Ionizing radiation is taking away from the court objective.	Vicious	Strengthen the system robustness and monitoring warning efforts.
7	Ionizing radiation taken out yard abnormally.	Vicious or Miss	Infrared monitoring on the court real-time.
8	Ionizing radiation taken out warehouse abnormally.	Vicious or Miss	The dose monitoring and RFID recognition in the warehouse.
9	Ionizing radiation dose is out of limits.	Vicious or Miss	Check shielding material Regularly.

6. Conclusion

People are highly sensitive to the pollution of ionizing radiation and radiation harms so the radiation protection is essential to social stability and construction of harmonious society. In the research, the cross-courses of management, strategy and information are used comprehensively and IT and the latest accomplishment of mathematics are to study the issues of management and strategy. The system, based on analyzing and evaluating the capability, availability, feasibility and reliability of agents related to radiation source, can sense the agents' purpose and desire and build a reliable ionizing radiation protection strategy-reliance and strategy-reasoning model based on i∗ frame. An IOT System of dependent Ionizing Radiationproof built on that basis can provide normal service even when the software system environment is disturbed, so it can serve the ecological and economical society with stability and development. What's more, i∗ model analysis process and the modeling accomplishment also can be applied to demand analysis of reliable software system for security, supervision and operation etc in nuclear power stations.

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References

[1] Wu Deqiang. Discussion on some issues relating to potential exposure for transformation of international bss into national. *Radiation Protection*. 1996; 05: 35-40.
[2] Qu J, Wang R, Zhang X, Tan H, and et al. The measurement theory of radioactivity in building materials*. Chinese journal Stones 6*. 2010; 6: 18-22.
[3] Luo X, Zhu M, Tang Z. *Literature* review on trustworthy software acquisition and analysis i*. *Application Research of Computers (in Chinese).* 2010, 3617-3621.
[4] Sheldon FT, Kavi KM, Tausworthe RC, Yu JT, Brettschneider R, Everett WW. Reliability measurement from theory to practice*. IEEE Trasactions on Software*. 1992; 9(4): 13-20.
[5] K Liu, ZG Shan, J Wang, JF He, ZT Zhang, and YW Qin. Overview on Major Research Plan of Trustworthy Software*. Bulletin of National Natural Science Foundation of China* (in Chinese). 2008; 22(3): 145-151.
[6] Fernanda A, Jaelson C, Gilberto C, John M. *From Early Requirements Modeled by the i* Technique to Later Requirements Modeled in Precise UML*. III Workshop de Engenharia de Requisitos (WER200), Rio de Janeiro, Brazil. 2000; 92-109.
[7] Yu E, Mylopoulos J. Enterprise Modeling for Business Redesign: the i*Framework. *SIGGROUP Bulletin*. 1997; 18(1): 59-63.
[8] Hugo E, Alicia M.R, Oscar P, Mylopoulos J. An empirical evaluation of the i*framework in a model-based software generation environment*. Advanced Information Systems Engineering Lecture Notes in Computer Science*. 2006; 4001: 513-527.
[9] Alistair GS, Neil AMM, Shailey M, Darrel M. Supporting Scenario-Based Requirements Engineering*. IEEE Transactions on Software Engineering*. 1998; 24(12).
[10] Günter G, Gerhard L, Matthias J, Thomas V. SNet: A Modeling and Simulation Environment for Agent Networks Based on i* and ConGolog*. Advanced Information Systems Engineering Lecture Notes in Computer Science*. 2006; 2348: 328-343
[11] Claudia PA, Carlos C, Juan PC, and et al. *A Comparative Analysis of i*-Based Agent-Oriented Modeling Languages*. Proceedings of the 17th International Conference on Software Engineering and Knowledge Engineering (SEKE'2005), Taipei, Taiwan, Republic of China. 43-50.
[12] Mylopoulos J, Borgida A, Jarke M, Manolis K. *Telos:* Representing knowledge about information systems*. ACM Transaction Information Systems*. 1990; 8(4): 325-362.
[13] Yu E. *Towards Modelling and Reasoning Support for Early-Phase Requirements Engineering*. Proceedings of the 3rd IEEE Int. Symp. on Requirements Engineering, Washington, USA. 1997: 226-235.
[14] Jin Z, Liu L, Jin Y. Software requirement engineerμprinciples and methods. *Encyclopaedia of Mathematical Sciences*, Beijing Science Press (in Chinese). 2008; 14.
[15] Souhaib B, Dr. Imran G. Measuring Security in Requirements. *Engineering International Journal of Informatics and Communication Technology* (IJ-ICT). 2012; 1(2): 72~81. ISSN: 2252-8776.