Extended Situational Awareness and Resilience in Healthcare Systems

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There is enough literature on situational awareness (SA) to establish it as an important construct in designing a socio-technical system. The tools and methods to measure SA are also available. The next course of action is to develop the conception and measure of extended SA, as opposed to individual SA. This need is even more pressing within the context of safety critical and dynamic organization, such as hospitals. In this context, human factor goals, such as safety, are understood by examining the normal variability within a system. This study aims to examine the utility of extended SA in a resilience engineering framework. This aim will be achieved by measuring the relationship between extended SA and dimensions of system's resilience. The outcomes of the study will help to clarify the role of extended SA in maintaining system's resilience.

Keywords: human factors, situational awareness, socio-technical system, safety resilience engineering, health care

The print media in Malaysia had exposed several undesirable events. These events can hardly to be classified as acts of nature. Rather, the types of events are commonly attributed to the humans. Examples of such events in the health care setting includes death during surgery, babies handed over to wrong parents, and patients turned violent because they were not attended to in a timely manner.

These misfortunes are closely related to the hospital system's resilience. In other safety-critical systems such as air port, nuclear plant, off shore drilling site, and military operations, resilience is of utmost importance to maintain safety and avoid disasters.

Situational Awareness

A definition of situational awareness is given by Endsly (1988) as "…the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future". This concept encompasses mental workload which has received a lot of attention from human factors researcher.

Several classes of methods for measuring situational were reviewed by Salmon et al. (2006). The classes of method include freeze probe techniques, real-time probe techniques, self-rating techniques, observer-rating techniques, process indices (eye tracker), and performance measures.

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In their review of the measurements of SA, Salmon et al. (2006) highlighted the inadequacy of the current assessment of SA for C4i (command, control, communication, computers and intelligence) systems. They concluded that the techniques themselves have inherent problems for data collection. Moreover, the "techniques fail to meet the requirements to assess SA across multiple locations at the same time, assess both individual and team SA for the same task and also assess SA in real time" (Salmon et al., 2006).

In her review of human factors for complex socio-technical systems, Carayon (2006) concluded that "(f)urther integrating the different dimensions and elements of sociotechnical systems is necessary to anticipate the implications of working across organizational, geographical, cultural and temporal boundaries". Her conclusion emphasized the necessity to go beyond the individual understanding of SA. With a complex socio-technical system such as the hospitals, an extended SA – as in SA for teams and SA for tasks in different temporal spaces – is indeed important to be understood.

Carayon's proposal is echoed by Siemieniuch and Sinclair (2006). They identified SA as one of the areas of concern for systems integration. However, rather than merely considering SA, they proposed extending the concept. Their argument for extending the concept is to integrate it with instantaneous and long term workload assessment. Moreover, the concept should be extended to include better understanding of team-working scenario.

An example of an attempt to understand team SA is found in the works of Sneddon, Mearns, and Flin (2006). They interviewed people working at an off-shore drill. Based on their study, several indicative factors that influence the creation, maintenance and degradation of SA were revealed. On top of that, the study also offers insights into factors that contribute towards team SA, such as having a good supervisor and consistency of staffing. However, as cautioned by the author, fundamental attribution error may bias the response gotten from the participants. Therefore, more studies are needed to uncover the external (circumstantial) factors that contribute towards the creation and maintenance of team SA.

Resilience Engineering

"Safety is something a system *does*, rather than something a system *has*." (Hollnagel, Woods, & Levenson, 2004). Recognising the limitations and the reactive nature of existing models of safety (or more accurately models of lacks of safety), a growing number of researchers are developing a new framework to understand safety and accidents. One such framework is resilience engineering. Rather than focusing on lack of safety, this framework attempts to measure, maintain and enhance presence of resilience which contributes towards safety and productivity. Hollnagel et al. (2005) stated that "(r)esilience engineering recognises the need to study safety as a process, provide new measures, new ways to monitor systems, and new ways to intervene to improve safety."

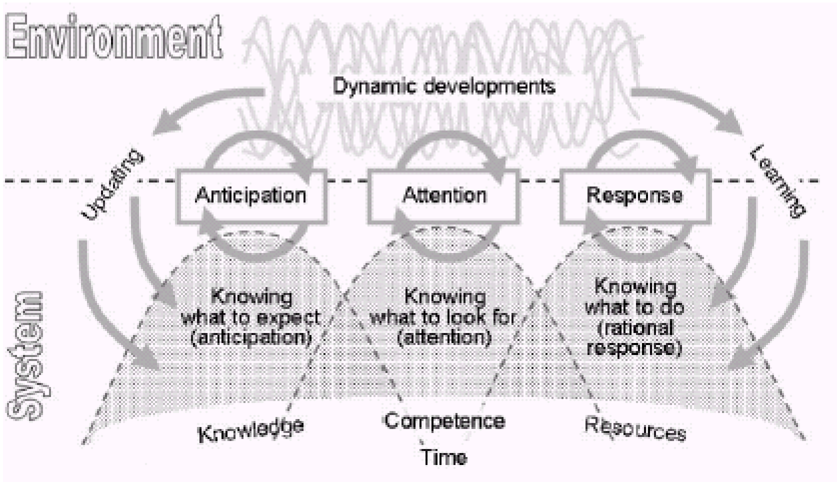

Figure 1. Required qualities of a resilient system.
Source: Hollnagel et al., 2005.

As evident in Figure 1, the requirements of a resilient system maps well with the very concept of situational awareness as defined by Endsley (1998). The attention requirement maps with perception, while anticipation maps with projection (of status). What this resilience model adds is the response. In other words, it also encompasses the part about “what to do with SA”. Therefore, it is not a far fetched idea that extended SA would contribute to an understanding of system’s resilience.

In outlining the agenda for the resilience engineering, Hollnagel et al. (2005) proposed that applied research should be conducted. The theoretical basis of resilience engineering is sufficient for such agenda, and “further advances in the resilience paradigm should occur through deploying the new measures and techniques in partnership with management for actual hazardous processes” (Hollnagel et al., 2005). In line with the suggested agenda, the present proposal is about the application of resilience engineering in health care system.

Studies on the application of resilience engineering have been conducted in different settings such as nuclear power plant, sea fishing industry, and chemical industry. For healthcare setting, Anders, Woods, Wears, Perry, and Patterson (2006) conducted a case study of an emergency department. They used a non-obtrusive observation technique. Based on this study, they identified “properties of resilience the way patient care is coordinated”. These properties can be the basis on which a quantitative measure of resilience can be developed. In other words, those properties of resilience are the potential dimensions of resilience.

Accidents, slip ups, and negligence in the hospitals can have severely negative consequences. This proposed study is important to get input to understand the resilience of a system.

Methods

This project will involve several studies, which are presented as follows. The sequence is not indicative of their chronological order. Several intermediate studies may need to be incorporated in the two studies described below.

The first study is on the development of quantifiable measure of resilience. Based on the literature (e.g., see Anders et al., 2006), a checklist will be developed. The checklist will be context specific to the intended setting (e.g., emergency department, operation room). This measure is not meant to be a full fledge scale to measure resilience. Rather, it is used to complement the qualitative approach in recording data. Therefore, this first study will not attempt to validate the measure beyond face validity.

The second study will be aimed at examining the contribution of extended SA to resilience. This study will be conducted on site with real-life staff and people at the hospital. Generally, a participative observation approach will be used. This approach includes video-taping of events, probing questions, post-event interview, and administration of questionnaire. The fluctuation or variability of resilience across the observation duration would be reflected in the self-report of the participants and also the data from checklist. This fluctuation would then be mapped against the data for extended situation awareness. In other words, there will be correlation analysis for the scores on resilience and situational awareness.

Expected Outcome

This thesis tries to expand on the concept of situational awareness (SA) and at the same time link it to resilience engineering. Based on literature review, SA are studied at the individual level for a particular task at one time. This thesis tries to push the envelop by expanding the SA construct to include team SA and intra-task SA. Contribution will also be made to rsilience engineering, itself in its infancy, by adding a new measuring tool. Based on previous qualitative studies, the author will establish a quantitave measure of extended SA. In short, this thesis will contribute towards the literature on the conceptual as well as measurement sides.

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