

A SHORT NOTE ON UNDERSTANDING NATURE OF UNCERTAINTY AND RISK IN HEALTHCARE DELIVERY SYSTEM - INFORMATION INTEGRITY BASED VIEW

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The supply chain of a modern healthcare delivery enterprise, seen as a system, is modeled as integral to a closed loop information and control system, which is designated as the healthcare process *IS* view (*HPIS* view). The *HPIS* view is a multistage decision process comprising decision stages of: (a) problem, i.e., goal information origination, (b) problem environment information origination, and (c) alternatives information origination to compare and select a customized, flexible healthcare information decision for control implementation for effective and efficient patient care.

The *HPIS* view consists of informational work system (*IWS*) and physical work system (*PWS*). *IWS* comprises information systems for the decision stages mentioned above. Based on flexible information decision delivered by the *IWS*, the process control systems (including physical variable control systems) of the *PWS* process material and energy inputs into service outputs. Process controls, in most cases, are information systems in the form of application controls (software). Information processing under these information systems is impacted by uncertainties, which for the *HPIS* view introduce implications of distortion and noise components.

The discipline of reliability engineering emphasizes a ‘noise’ component. The concern here is *inexactness*, i.e., insufficient fullness or incompleteness of the information processed in the *PWS*, which defines information *exactness* requirement in terms of reliability attribute. However, ‘distortion’ and ‘noise’ components have implications of *incorrectness*, i.e., biased or misleading information (which may also be noisy), i.e., insufficiently perfect originating and processing of information. Given that for effective and efficient patient care the *HPIS* view must originate and process *correct* information, this requires defining information *correctness*, i.e., integrity requirement. Integrity is the inverse amount of distortion and noise present. Determinants of Information Integrity (I*I), therefore, are the attributes of accuracy (A), consistency (C), and reliability (R), and the requirement for I*I in the *HPIS* view can now be seen as consequence of the uncertainties at *IWS* and *PWS*.

Associated with uncertainty is the important concept of risk. Given the uncertainty implications leading to distortion and noise, the risk that information origination and processing under the *HPIS* view has is that of selecting a healthcare information decision *ex ante*, which will, according to the *ex ante* estimate of the *HPIS* view, perhaps turn out to have been sub-optimal, i.e., ineffective and inefficient (and in some situations even harmful) *ex post*. The components of this *ex ante* risk are: (i) Usability Risk, and (ii) I*I Risk, which in turn is comprised of: (a) Information Correctness Risk (*ICR*) and (b) Information Exactness Risk (*IER*). While usability risk signifying limits to the decision process by itself is irrelevant to determine which

information decision to select, it is by controlling I*I at the decision stages of the *HPIS* view that I*I risk can be minimized (controlled), and this will result in effective and efficient healthcare delivery.

Many further significant observations emerge. I*I risk is required to be minimized at each of information origination (decision) stages of the *HPIS* view. This suggests I*I as a system's concept for error reduction. Information origination and its integrity analysis are *costly* activities. This points to a cost benefit analysis framework for analytically executing I*I control. All this suggests that uncertainty and risk *are* different and that healthcare I*I risk *is* transferable. This presents I*I Technology development as a market opportunity (markets are good at shifting risks).

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