

### **Evidence-Based Design of Service Systems**

*Moving the locus of value creation from exchange to use, or context, means transforming our understanding of value from one based on units of firm output to one based on processes that integrate resources. We think this move is fundamental for the development of service science, which aims to focus scientific attention on problems associated with innovating service and enhancing service provision (Chesbrough and Spohrer, 2006; Spohrer et al., 2006). And we think the service system is a useful abstraction for understanding value and value co-creation in this way (see also Maglio and Spohrer, 2008 and Spohrer et al., 2008). Specifically, for service systems, we define value simply in terms of an improvement in system well-being and we can measure value in terms of a system's adaptiveness or ability to fit in its environment.*

*Vargo, Maglio, and Akaka (2008)*

Service systems are sociotechnical systems in which technical and human capabilities interact within a social context to accomplish work that is a service rather than a physical artifact. As pointed out above, the value of this work cannot be based on the exchange of units of output. For example, what are the units of output of a system to enhance situational awareness in an emergency operations center and with whom are they exchanged? It is the work, the accomplishment of a mission, which represents value in these systems, and therefore a service system's value lies in the enhanced achievement of a mission.

Central to the success of service systems are not only physical resources (vessels and beds and medicine) but also information resources that are needed to accomplish a given task and are produced by these tasks for use in other tasks. Information resources differ from physical resources in that they can be in multiple places at once and their use does not diminish their availability (in fact, it increases it). The alignment of resources with work is central to the design of a service system, and this is particularly true of information resources.

The design of a service system makes it easier for people to work some ways and harder to work other ways. Via a system's affordances and constraints, both intentional and unintended, system designers make some interactions intuitive and easy and other interactions more difficult or impossible. Thus when we design a system (or an intervention or change to an existing system), we are designing the workflow for delivering the service that system is intended to support. The key to good service system design is to understand the desired workflow and then make that desired workflow the easiest course of action, while reducing unintended consequences that result in useless workarounds or even detrimental actions.

Service systems are complex configurations of people, technologies, organizations and information, and this complexity makes service system design particularly challenging. System stakeholders may have different priorities; design decisions often require stakeholders to evaluate tradeoffs between competing interests and needs. However, it is imperative that we account for the complexity of service system configurations in service system design. Failure to account for this complexity will result in unintended negative consequences. Human Centered Design (HCD) recognizes the need to ground design in an understanding of such configurations including the identification of both direct and indirect stakeholders and a clear understanding of these stakeholders' needs in the context of their work. [3]

In a work centered approach, we replace the notion of measuring success as the value of the service provided with measuring improvements to the processes that people follow to achieve a desired mission. We base design decisions on predictable, measureable benefits to the work. We work directly with stakeholders to understand their processes and needs. We empower stakeholders to define desired services and enhanced information requirements to achieve those services. Also central to this approach is the view that technology is not designed to provide a capability to workers (with unknown impacts on their work), but rather that the impact on work must be part of the technology design. In addition, many other interventions than technology are among the possible enhancements to service work. For example, investigation into the work system under design might reveal a need for a different policy rather than a different technology.

HCD has evolved a number of techniques for work and information centered design, central to which are ethnographic methodologies. Ethnographic methods can be combined with other research methods from human factors and software engineering in ways that enable researchers to identify measures of “success” beyond efficiency. These include evidence-based approaches such as computational modeling and simulation that incorporate work and information flow. [7-11] These approaches can enable both *formative evaluation*, which occurs throughout the design process in time to guide design decisions, and *summative evaluation*, which occurs after the design has been implemented and is used to measure whether it has had the intended effect. These combined design-evaluation techniques have proven successful for designing technology in complex service systems, such as healthcare, [7, 12] that reliably help rather than harm.

Service system designers can also draw guidance from the aviation sector. Improving service delivery in aviation required a reevaluation of who is a member of the “team,”[14] and the safety culture for which aviation is praised is attributed to collaboration among stakeholders beyond the cockpit, including regulators such as the Federal Aviation Administration (FAA) and the International Air Transport Association (IATA), airlines, aircraft manufacturers, and software/hardware vendors. As Middleton et al. point out, “no single measure alone accounts for [the] success [of the aircraft industry]....” [15] Similarly, identifying the appropriate methods and metrics by which to evaluate a system’s success requires broad collaboration among government and private sector entities, regulators, researchers, designers, and service recipients.

Thanks to the organizers of this workshop, we have brought representatives of such a collaborative team to share our experiences and ideas. National security relies on numerous, often interconnected, service systems, and the success of these service systems depends on aligning the work and missions of numerous organizations and agencies with systems that deliver the right information to the right people at the right time. To tackle this design challenge, the University of Washington’s Department of Human Centered Design & Engineering (HCDE) is working with a large number of Federal, State, local, tribal, international, industrial, public and professional organizations to better understand how the Puget Sound region currently achieves maritime security. Based on this understanding, we will work with this community and our Federal sponsors to articulate enhancements to current service systems—enhancements that are motivated by predictable, measureable improvements to the accomplishment of the maritime security mission.

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