Service Systems Background

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Economies are pre-disposed to follow a developmental progression that moves them from heavy proportional reliance on agriculture and mining toward the development of manufacturing, and finally toward more service-based economic activity. As reported by the Organization for Economic Co-Operation and Development (OECD) in its "Science, Technology, and Industry (STI) Forum on The Service Economy":

> *The reason that we see a services economy today, and gather to talk about it and recognize its importance is because technology has allowed service industries to gain the operational leverage that manufacturing achieved 100 years ago. In addition to banks, health systems, telephone and telecommunications networks, and distribution and retailing firms are further examples of sectors that have been able to benefit from economies of scale. As a result, we are now living in a world where global-scale service companies exist for the first time, whereas we have seen global manufacturing companies for 50 years or more.* (OECD 2000, 8)

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The typical industry example given of this progression toward services is the company International Business Machines (IBM). Even though IBM still produces hardware, they view their business as overwhelmingly service-oriented wherein hardware plays only an incidental role in their business solutions services; the fastest line of business growth within IBM has been the business-to-business (B2B) services: information technology (IT); for example, data centers and call centers; business process outsourcing/re-engineering; systems integration; and organizational change.

Business to government (B2G) is forecasted to have the fastest growth in the years to come (Spohrer 2011). For IBM, this trend started in 1989 with the launch of business recovery services; it accelerated with the acquisition of Price-Waterhouse Coopers Consultants in 2002 and culminated with the 2005 sale of the laptop (ThinkPad) manufacturing, their last major hardware operation.

IBM exemplifies the services trend which has accelerated in the last 25-30 years and as of 2006, the services produced by private industry accounted for 67.8% of U.S. gross domestic product (GDP). The top sub-sectors included real estate, financial, healthcare, education, legal, banking, insurance, and investment. Production of goods accounted for 19.8% of GDP. The top product sub-sectors included manufacturing, construction, oil and gas, mining, and agriculture (Moran 2006).

Beginning in the mid-1990s, the concept of a product-service system (PSS) started to evolve. PSSs have been adopted by businesses interested in using the model to bring not only added value to their existing offerings, but capital-intensive, environmentally favorable products to market (Mont and Tukker 2006).

There are some definitional issues in any discussion of PSS, including the fact that services can sometimes be considered as products, and services invariably need physical products to support their provisioning or delivery (2006). A PSS is comprised of tangibles and intangibles (activities) in combination to fulfill specific customer requirements, or ideally, to allow applications to be co-created flexibly by linking loosely coupled agents, typically over a network (Domingue et al. 2009). Research has shown that manufacturing firms are more amenable to producing "results" rather than solely products as specific artifacts and that end users are more amenable to consuming such results (Cook 2004; Wild et al. 2007).

The popularity of wikis, blogs, and social networking tools is strong evidence that "Enterprise 2.0" is already well under way; Andrew McAfee describes Enterprise 2.0 as "the use of emergent social software platforms within companies, or between companies and their partners or customers" (McAfee 2009). However, the integrated access to people, media, services, and things, provided by the Future Internet, will enable new styles of societal and economic interactions at unprecedented scales, flexibility, and quality. These applications will exploit the wisdom of crowds and allow for mass collaboration and value co-creation.

The future internet will provide location independent, interoperable, scalable, secure, and efficient access to a coordinated set of services (Tselentis et al. 2009), but such a broad vision demands a sound and well-defined approach for management and governance.

Current application service providers like Amazon, Facebook, Twitter, eBay, and Google must mediate between the business challenges enabled by network and IT convergence and customers (enterprise or consumer) demanding new and more value-adding services enabled by social networks (TMFORUM 2008). The differences between IT and communications technologies are disappearing; internally-focused processes (back-stage processes) for operations optimization are now being strongly tied to the customer facing (front-stage) processes for value co-creation and delivery.

In this scenario, the enterprise’s internal organization and employees are embedded in the service value chain to benefit customers and stakeholders. In the service-dominant logic (S-DL) for marketing (Vargo and Lusch 2004), service is the application (through deeds, processes, and performances) of specialized operant resources (knowledge and skills) for the benefit of another entity or the entity itself. The emphasis is on the process of doing something for, and with, another entity in order to create value; a service system is thus a system of interacting and interdependent parts (people, technologies, and organizations) that is externally oriented to achieve and maintain a sustainable competitive advantage (IFM 2008; Maglio and Spohrer 2008).

The future internet is expected to be more agile, scalable, secure, and reliable, demanding rapidly emerging applications/services with different requirements and implications for the Future Internet design that pose a significant set of problems and challenges, in particular, “the fragmentation of knowledge and the isolation of the specialist as well as the need to find new approaches to problems created by earlier 'solution of problems,'” (Skyttner 2006). The service systems engineering discipline may inform the discussion and offer potential multidisciplinary environments and trans-disciplinary solutions.

The internet has been successfully deployed for several decades due to its high flexibility in running over different kinds of physical media and in supporting different high-layer protocols and applications, including traditional file transfer, email, and client-server-based Web applications, among others.

Business Dependence on Service Systems

Most people and enterprises are heavily dependent on service interactions, including entertainment, communications, retail, education, healthcare, etc., brought about by emerging services, such as video on demand, web conferencing, time-shift services, place-shift and device-shift services, enterprise applications (e.g., enterprise resource planning (ERP), customer relationship management (CRM), manufacturing resource management (MRM), software configuration management (SCM), etc.), software as a service (SaaS), platform as a service (PaaS), cloud services, peer-to-peer (P2P) services, etc. A common denominator in the set of services mentioned is that applications are offered as services by the interaction of service system entities and thus they are service based applications (SBA).

Thus, “A service based application is obtained by composing various service system entities to satisfy the desired functionality” (Andrikopoulos et al. 2010). SBAs are heavily dependent on web services development, such as Web services 2.0 (WS). Software systems engineering (SwSE) plays a very important role in a business dependent on a service system. However, another important role is played by human interfaces, organizational development and technology development; for instance, governance (rules & regulations) and technology research and development are required for future services in healthcare services, intelligent transportation services, environmental services, energy services, etc. to address societal challenges of the 21st century (sustainability, energy, etc.) as presented by (Vest 2010) if we were to face those challenges as an ecosystem.

Service System Example

In an intelligent transport system-emergency transportation operation (ITS-ETO), the service goal is to provide safe evacuation, prompt medical care, and improved emergency management service. Typically, a traveler can request service through an emergency call or automated crash report feature, or a public safety officer on location can request service based on customer features and access rights.

The ITS-ETO service system utilizes advances in communication and information systems (technology and information enabler) to access essential, real-time data about conditions on routes throughout the affected area and coordinate operational and logistical strategies in cooperation within all service entities (organization processes). In a critical emergency situation, when patient conditions are continuously changing, ITS can help identify the appropriate response and get the correct equipment (infrastructure enabler), such as a helicopter and emergency personnel (people enabler), to and from the scene quickly and safely.

Efficient and reliable voice, data, and video communications (application enabler) further provide agencies with the ability to share information related to the status of the emergency, the operational conditions of the transportation facilities, and the location of emergency response resources to help communicate and coordinate operations and resources in real time. Advances in logistical and decision-making tools can enable commanders and dispatchers to implement strategies as conditions change (decision making).

It is also critical to receive information on the environmental conditions (storm, hazardous materials, multi-vehicle crashes, etc.) and/or road closures when coordinating evacuations. The availability of real-time data about transportation conditions, coupled with decision-making tools, enables more effective responses and coordination of resources during emergencies. ITS-ETO also enhances the ability of transportation agencies to coordinate responses with other stakeholders/entities.

As a result, increased data accuracy, timeliness, and automation leads to better use of resources, and reuse of exchanges, resulting in time and cost savings. Enhanced response and management leads to greater situational awareness and more effective reactions with the ability to identify and utilize the appropriate equipment, resulting in a more efficient response at the right time (output) (US DOT 2011). Figure 1 below lists the possible stakeholders in a service system.

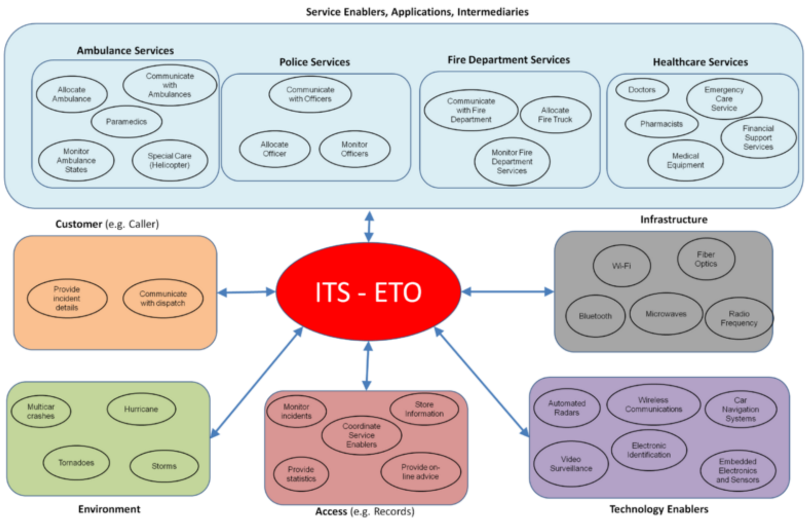

Figure 1. Service System Context Diagram. (SEBoK Original)

As seen in the above example, the service activities are knowledge-intensive; well defined linkages (including access rights) and relationships among different entities give rise to the needed service systems interactions for the service system to be successful. As the world becomes more widely interconnected, and people become better educated, the services networks created by the interaction of the service systems will be accessible from anywhere, at any time, by anyone with the proper access rights.

Knowledge agents are then humans creating new linkages of information to create new knowledge which “can later be embedded in other people, technology, shared information, and organizations." Thus, people can be considered as individual service systems with “finite life cycles, identities (with associated histories and expectations), legal rights and authority to perform certain functions, perform multitasking as a way to increase individual productivity output in a finite time, and engage in division-of-labor with others to increase collective productive output in finite time" through service transactions enabled by their access rights (Spohrer and Kwan 2008).

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