

# Chapter 18

## Design Science Research: Looking to the Future

*The best way to predict the future is to invent it.*

– Alan Kay

### 18.1 Introduction

The previous chapters have taken you through the fundamentals of design science research, the problems, solutions space, design process, frameworks, outputs and artifacts, theories and dissemination of the research results. The design science research paradigm is highly relevant to information systems (IS) research because it directly addresses two of the key issues of the discipline: the central, albeit controversial, role of the IT artifact in IS research (Weber 1987; Orlikowski and Iacono 2001; Benbasat and Zmud 2003) and the lack of professional relevance of IS research (Benbasat and Zmud 1999; Hirschheim and Klein 2003). Design science, as conceptualized by Simon (1996), supports a pragmatic research paradigm that calls for the creation of innovative artifacts to solve real-world problems. Thus, design science research combines a focus on the IT artifact with a high priority on relevance in the application domain.

The last few years has been particularly exciting for the IS design science community as there have been a steady increase in discussions, papers, projects, and conference themes and tracks that surround design science research. The momentum behind the research method is gathering and there is now increased recognition within the larger IS community of the rigor and relevance of this science.

How will these trends continue in the future? Predicting the future is not easy and we do not intend to do that. However, we can discuss four possible trends that are likely going to happen in one way or another. We have discussed some of these ideas throughout the book but put a futuristic lens in the presentation that follows.

## **18.2 Trend 1: Growing Number of IS Scholars Will Use Design as a Research Method**

As information technology itself evolves, we find ourselves in uncharted territories. Those wicked problems emerge everyday. Solving those problems through the creation of IT-based artifacts will be necessary. We predict a large number of future IS scholars will be conducting such type of work.

Scholars will use design as the central research method and their labor will be fundamentally driven by trying to solve the problem. Knowledge will be used and new knowledge will be created in the process of building and evaluating the artifact. Hence the build–evaluate cycles that have been presented in the book will come in handy. These scholars are driven by proving utility and efficacy of their solution as opposed to forming hypothesis and proving facts or truths. Innovative thinking along with creativity will largely drive what they do. The novelty of the solution is equally compelling to them.

The domain knowledge of the problem will be very important to the success of such efforts. Technical grounding in the subject matter, making sure that relevant research literature has been covered, and having a laboratory environment to build and break artifacts will be crucial toward achieving success.

If this trend turns out to be true, then the IS community will be well positioned to contribute toward fundamental wicked problem solving. It will become a reference discipline from which other related disciplines can borrow.

## **18.3 Trend 2: Growing Number of Scholars Will Research Design**

There will be a set of researchers who will conduct descriptive research by studying design and designers. Their driver is to understand what process designers follow when they encounter a design problem. A case study approach is well suited to do this study. Some of the techniques presented in this book will come in handy to do that.

This camp of researchers are interested to learn from successful design as well as why certain designs fail. They are after what Vesuvius stated as form, elegance, and beauty in designed artifacts. This is an important contribution as this eventually could become a body of knowledge from which theory can be built. They deal with more meta-level problems. They are conducting pattern recognition in the sense when a problem is presented; they may help identify a certain pattern in design and could potentially solve the problem. The domain of their work tends to be more organizational and socio-technical in nature.

There are other disciplines that study design patterns and designers. One question to ponder is that what do IS scholars bring to the table? To distinguish their work, it will be important to scope the domain of study to IS problems and software development design issues. Will design process embraced in industrial design easily

lend itself to software service design? Are there patterns that readily apply to design problems in IS?

### **18.4 Trend 3: A Small but Steady Number of Scholars Will Study Design Theory**

Theories epitomize scientific knowledge. They are often considered the crown jewels in the discovery process. But in this book we have stated that the jury is still out about design theory with respect to two issues: (1) Is theory a necessary type of output artifact in DSR? and (2) Is design theory possible?

We anticipate that in the future, we will continue to see breakthroughs happening in study of design theory. But it is important to realize that any design theory when built should be applicable to design practitioners. They should include normative statements that describe for a particular class of problems, if one adopts a certain design solution, one can expect to get a certain outcome.

The work done by this scholar community is driven by the need to understand why certain designs work? The theory should have predictive capability and should be generalizable across the class of problems.

### **18.5 Trend 4: An Uptake Is Expected in These Three IT Application Area Thereby Creating a Surge in the Need for Design Researchers**

Information technology has been a major driver and key enabler toward a global information society. IT has affected every major industry sector from telecommunications, education, supply-chain systems, transportation, railways, airlines, entertainment, banking, trading, and others. There are other sectors that continue to embrace IT to help them grow and achieve their goals. In this section, we discuss three industry verticals that are showing signs of uptake in the next decade. Of course in a fast-changing economic situation, there is never any guarantee that these sectors will continue to grow. But based on 2009 data, we can expect the following three verticals to prosper for the coming decade. They are health-care sector, green technologies for climate, and collaboration and social networking area.

#### ***18.5.1 Health Care and IT***

In 2005, a report published in the *Journal of the American Medical Association* found that as many as 98,000 Americans die each year because of medical errors (Weingart, 2005). In that same year, more people died due to medical errors than from Alzheimer's, HIV, automobile fatalities, suicide, homicide, or hypertension. An Institute of Medicine study published in 2000 estimates that medical errors

cost the nation about \$37.6 billion each year; about \$17 billion of those costs are associated with preventable errors.

The need for reform stems from long-standing problems in our health system, and the central role of information technology derives from an ever-expanding body of research and experience that attests to its merit in addressing these problems. Despite the fact that the United States spends more on health care than any other country, both in absolute numbers and on a per capita basis, the health status of Americans ranks relatively low when compared with that of people in other developed nations. Moreover, the general discrepancy between expenditures and health status indicators in the United States masks significant differentials among segments of the population, based on socio-economic, geographic, cultural, ethnic, and other factors. Hence, we continue to suffer from inequities in access to health care, inefficiencies in the delivery of care, escalating costs, and the prevalence of adverse lifestyles that exacerbate these problems.

Health IT is about bringing safety and efficiency to the health-care system. Patients seeking treatment have enough to worry about; if one can alleviate the fear that an error will occur, one needs to try to do that. A secure, uniform, interoperable system that works for patients and providers will save time, stress, and money. The digital age has transformed virtually every other sector of the economy; it is time to bring the tremendous benefits of technology to the health-care system.

A number of promising technologies are being designed and implemented within the health-care industry. Electronic medical records (EMRs) will replace the paper-based charts and are shown to reduce medical errors (IOM 2003; Harrison et al. 2007). These EMR systems will be all interconnected via a national health information network (NHIN) that will aggregate case data to a national database that can then be analyzed by data mining experts and epidemiology researchers to mine for trends in emerging diseases. Regional health interoperability exchanges need to be designed and built to connect various systems together. Health IT systems that warn against drug interactions, e-prescription systems, telemedicine systems (Tulu et al., 2007), and clinical decision support systems (Bates et al., 2003) can all lead to an error-free health-care system that provides higher quality.

The design challenges in health-care IT systems stem from the fact that there are multiple stakeholders whose interests have to be met. There are physicians who often are not willing to learn or adopt such systems. There are payers (Medicare, Medicaid, insurance companies, and HMOs) who need to review billing claims. The drug manufacturers need access to clinical data while medical device OEMs also need to view data. Finally there are the patients (you and me) who would like to control our own medical data in a secured manner. Hence there is active research being conducted on personal health records (PHRs) and HIPAA compliance.

### ***18.5.2 Green Technology and Green IT***

Environmental scientists point out that global warming is a serious threat. Greenhouse emission is the major cause of global warming. There is worldwide

activity to control climate change and produce clean energy. A carbon footprint is a measure of the impact our activities have on the environment, and in particular climate change (Carbon Footprint 2009). It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating, and transportation. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kilograms) of carbon dioxide equivalent. All activity is geared to lower our carbon footprint.

A carbon footprint is made up of the sum of two parts, the primary footprint (shown by the darker slices of the pie chart) and the secondary footprint (shown as the lighter slices) (Fig. 18.1).

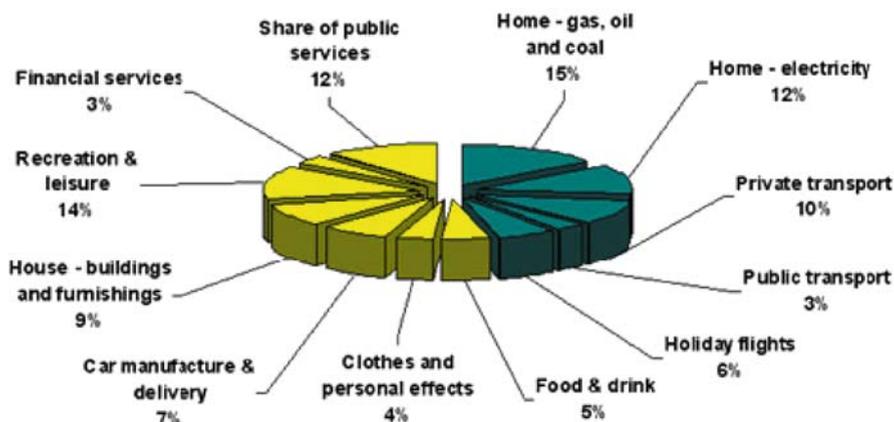


Fig. 18.1 Main elements which make up the total of a typical person's carbon footprint in the developed world

1. The *primary footprint* is a measure of our direct emissions of CO<sub>2</sub> from the burning of fossil fuels including domestic energy consumption and transportation (e.g., car and plane). We have direct control of these.
2. The *secondary footprint* is a measure of the indirect CO<sub>2</sub> emissions from the whole life cycle of products we use – those associated with their manufacture and eventual breakdown. To put it very simply, the more we buy the more emissions will be caused on our behalf.

Renewable energy is clean, safe, and inexhaustible but it is also vastly underused. Switching to green energy is one of the easiest and quickest ways to reduce your carbon footprint. If we switch to renewable energy it is most likely to be coming from wind power or hydroelectric power. Other sources include solar power and wave and tidal energy. There are also other largely untapped sources such as biomass, landfill gas energy, and combined heat and power (known as chp). It is also possible to install solar water heating and small wind turbines on to your own house.

### 18.5.3 Green Computing

Green computing is the study and practice of using computing resources efficiently (Green Computing, 2009). The primary objective of such a program is to account for the triple bottom line, an expanded spectrum of values and criteria for measuring organizational (and societal) success. The goals are similar to green chemistry; reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote recyclability or biodegradability of defunct products and factory waste.

Modern IT systems rely upon a complicated mix of people, networks, and hardware; as such, a green computing initiative must be systemic in nature and address increasingly sophisticated problems. Elements of such a solution may comprise items such as end user satisfaction, management restructuring, regulatory compliance, disposal of electronic waste, telecommuting, virtualization of server resources, energy use, thin client solutions, and return on investment (ROI). The imperative for companies to take control of their power consumption, for technology and more generally, therefore remains acute.

Some areas where designers can create or improve new technologies for green computing are the following:

**Algorithmic efficiency:** The efficiency of algorithms has an impact on the amount of computer resources required for any given computing function and there are many efficient trade-offs in writing programs. As computers have become more numerous and the cost of hardware has declined relative to the cost of energy, the energy efficiency and environmental impact of computing systems and programs have received increased attention.

**Computer virtualization:** This refers to the abstraction of computer resources, such as the process of running two or more logical computer systems on one set of physical hardware. With virtualization, a system administrator could combine several physical systems into virtual machines on one single, powerful system, thereby unplugging the original hardware and reducing power and cooling consumption. Several commercial companies and open-source projects now offer software packages to enable a transition to virtual computing. Intel Corporation and AMD have also built proprietary virtualization enhancements to the x86 instruction set into each of their CPU product lines, in order to facilitate virtualized computing.

**Telecommuting:** Teleconferencing and telepresence technologies are often implemented in green computing initiatives. The advantages are many; increased worker satisfaction, reduction of greenhouse gas emissions related to travel, and increased profit margins as a result of lower overhead costs for office space, heat, lighting, etc. The savings are significant; the average annual energy consumption for US office buildings is over 23 kWh per square foot, with heat, air conditioning, and lighting accounting for 70% of all energy consumed.

The McKinsey report offers a concise statement of the issue of green IT: “The rapidly growing carbon footprint associated with information and communications technologies, including laptops and PCs, data centers and computing networks, mobile phones, and telecommunications networks, could make them among the biggest greenhouse gas emitters by 2020. However, our research also suggests that there are opportunities to use these technologies to make the world economy more energy and carbon efficient.”

### ***18.5.4 Collaboration, Web 2.0, and Social Technologies***

When the World Wide Web first started, it was mainly web sites that provided one-way information to clients. The content and the sites were created by techies who knew HTML and other associated tools. But over time, the web evolved into a two-way information highway where any average user could also post, blog, write, and share content using very easy-to-use tools. A plethora of tools that are mostly available free exists today. Among the most popular tools are blogs, wikis, RSS feed, mashups, voice over IP, and instant messaging services, podcasting, video services such as YouTube, and several social networking sites (such as Facebook and Twitter).

As the Internet became a global platform for business, it also transformed the way people collaborate across countries and time zones. Designers today work cooperatively to design cars, engines, products, and design new IT solutions. Companies have distributed teams that operate out of different countries. These distributed teams are using various technologies such as real-time videoconferencing, VoIP, shared presentations, project management tools, mindmapping tools, web presenting tools, screen sharing and remote control. This in turn encourages global awareness, creativity, innovation, critical thinking, and collaboration. It is transforming the way we learn, get news, share our photos and videos, plan our travel, or look for entertainment. Web 2.0 along with social networking sites can help us achieve healthy living, be better prepared for tomorrow’s challenging tasks, and become knowledgeable citizens for the 21st century workforce.

In the beginning we have mentioned that it is foolish to predict. Yet we will end the book with a prediction. *The future will require more designers and design science researchers.* This is something on which we are willing to bet!

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