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Go for it: Where IS researchers aren't researching

Viewpoint

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Abstract:
This viewpoint article describes two research topics under-researched by Information Systems (IS) researchers: Robotics and IT addiction. These topics offer great potential for IS researchers in terms of business and societal impacts and it would behoove IS researchers to study them more fully. The aspects of the research topics that are related to IS are discussed and potential research areas and questions are suggested.

Keywords:
robotic technology; robots; IT addiction; dark side of IT; research areas.

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1. Introduction

In the first decade of the new millennium, there was a big debate about what Information Systems (IS) discipline is and is not. Many IS researchers provided their two cents about an identity crisis in the IS discipline, the most notable of which were the comments by Benbasat and Zmud [1] and Agarwal and Lucas [2]. Relatedly, there were attempts to identify the IS intellectual core by Sidorova, Evangelopoulos, Valacich and Ramakrishnan [3], as well as others in a Special Issue of the Communications of the Association for IS in 2003.

Concomitantly an exciting new era of research about electronic commerce was revving up. Our view is that the IS discipline was slow to enter the conversation about electronic commerce (e-commerce). Maybe it was because many IS researchers thought that research in this area was outside the IS core. Maybe it was because the IS journals were too demanding about requiring rigorous methodology and strong theory in the research on this still emerging phenomenon. Whatever the reason, while IS journals considered the merits of research on e-commerce, the marketing researchers, never shy, rushed in and gained a strong foothold on the market for e-commerce research. IS researchers eventually joined the party, but it was after marketing departments were offering courses and marketing researchers were publishing research to understand this new phenomenon.

Another example of attempting to limit the reach of IS research was experienced by one of the authors when she served as Senior Editor on a gamification paper [4]. Members of the review team voiced their concern that the topic, gamification, was not appropriate for MISQ when the manuscript was first submitted around 2010. However, it is now clear that gamification is not only important to millennials, but also to companies like Uber and UPS that are using it to control their workers [5]. Further, it is clear that gamification is a legitimate topic for IS researchers.

We believe that the IS discipline can play an even more important role in the current digital era that is ripe with new technologies and innovations. IS researchers have recognized the huge potential societal and business impact that big data, business analytics, Artificial Intelligence (AI) and machine learning offer, and they are actively engaging in research on these topics - research topics that are being explored concomitantly in other disciplines such as marketing and management. Almost weekly there are calls for papers for Special Issues in IS journals on these topics and related tracks are popping up in major and boutique conferences alike.

Ironically there are several research topics with rich potential that are not being widely addressed by IS researchers. We would like to bring two of them to your attention: robotics and IT addiction. With a few exceptions that we note below, we have not seen these topics published in IS journals. Further, with the exception of HICSS which has a minitrack on Machine Learning, Robotic and Toy Computing and ICIS which has a Human Computer/Robot Interactions and Interfaces track and mentions it as a topic in the Human Behavior and IS track, we have not seen specific tracks or minitracks for either Robotics or IT addiction at major IS conferences. We would like to draw on our recent book, Emotional and Cognitive Overload: The Darkside of Information Technology, by describing why these two topics might be of interest to IS researchers and outlining potential research areas. When it comes to doing research on these topics, we would like to encourage IS researchers: Go for it!

2. Robotics

Robots are hardly a new thing. The first one was developed by Archytas of Tarentum in the third century. It was a steam-powered mechanical bird called "Pigeon." In 1495, Leonardo da Vinci created a robot from a knight's suit of armor and an internal cable mechanism. It was not until the 20th century, though, when they were installed into assembly lines, mostly automobile assembly lines, that robots became more commonplace.

By robot we mean "a reprogrammable, multifunctional manipulator designed to move material, parts, tools or, or specialized devices through variable programmed motions for the performance of a tasks" [6, p. 70]. The term 'robot' was derived from the Austro-Hungarian empire term, robota, which means "vassal" or "worker" and first appeared in Capek's 1921 play Rossum's Universal Robots, or R.U.R. [7].

GM first put a robot (i.e., George Devol's industrial robotic arm) to work on its assembly line in 1961. GM's first robots were used for die casting, welding, and painting operations. Twenty years later, 300 robots were working on GM's factory floor [6]. Now the number of robots working at GM has mushroomed to over 30,000 [8]. Other car companies have followed GM's lead by placing robots on their assembly lines. Recently, the industries showing the greatest growth in robot density are transportation equipment, metal industries and chemicals [9]. The science of robotics was initiated in 1959 in MIT's Artificial Intelligence Laboratory by John McCarthy and Marvin Minsky on one coast and at Stanford University on the other coast. A little later, business organizations also were conducting their own robotics research. Because of this research, today's robots boast anthropomorphic cognitive capabilities which are based on AI. Further, their physical form is designed to match the function(s) they perform - and do so reliably, predictably and safely [7]. Increasingly robots are becoming valued members of industrial teams as they work alongside humans (e.g., as cobots).

2.1 Reasons for Using Robots

Industrial robots are used increasingly because they perform the work accurately, efficiently and at ever-lower costs. They are especially useful in performing tasks that are "dangerous, dirty, or dull". They can lift and move heavy objects reliably and repeatedly with an accuracy that is within a small fraction of a millimeter [10]. They can perform numerous warehouse functions. For example, Amazon uses an army of over 100,000 robotic systems in its 25 fulfilment centers around the globe. Its varied robotic systems are designed to perform a range of tasks including transporting packages, sorting packages by booting them into desired chutes, handling pallets, and working with human employees who pick and stow the packages. Amazon claims that its use of robots has helped it store an additional 40 percent of inventory in its fulfilment centers [11]. Southern Glazer's Wine and Spirits LLC, the largest alcoholic-beverage distributor in North America, uses robots to support order routing, pallet and case conveyor systems, and voice directed picking in its Leesburg, Florida plant. Its highly automated system allows it to process a remarkable 12,000 cases an hour [12]. Robots also can be found cheering up the elderly in Japanese retirement homes, performing minimally-invasive laparoscopic surgery, checking the quality of welds, detonating bombs, driving cars, delivering anesthesia (by a robotic system called McSleepy), giving priestly blessings (by a robotic system called BlessU-2), and working on the International Space Station [10; 13; 14; 15]. Increasingly they can be used to perform tasks that are non-routine and have cognitive and emotional, as well as physical, components [13].

It is likely that the use of robots will increase as their price plummets. Over the last 30 years, the price tag for a typical robot has halved both in real terms and in relation to labor costs [9; 16]. Graetz and Michaels [9] estimate that increased use of robots contributed to annual labor productivity growth and total factor productivity, though at diminished marginal gains. Further, the efficiencies, increased storage, labor savings, and other operational improvements that their use stimulates makes robots even more appealing in industry. For example, a recent New York Times article about Dynamics, a manufacturer of molds for the mass production of small plastic and metal parts, notes: "The robot's price tag was $35,000, and within two months, it paid for itself by quadrupling the efficiency of the press and eliminating scrap" [8, p. 32].

Robots are perceived as an efficient way to alleviate or avoid human errors. Indeed, the operating system of humans (i.e., brain) is delivered at birth full of defects (e.g., with cognitive biases and emotion). The actual trend is therefore to introduce smarter systems and more software to empower robots' actions. Indeed, scientists are working on developing "evolved" robots with human traits, emotions, and intentions that can be trusted. The increased use of robots may lead to more varied, often more creative and highly skilled, jobs with reduced day-to-day drudgery. The end result is that people may have more time to enjoy their lives (e.g., [13; 17]).

2.2 *On the Dark Side of Robotic Technology*

There are several dark sides of Robotic Technology: Safety, dangers resulting from their incorrect use, and negative impacts of their use on human workers. Safety is the oldest known dark side of robot technology in manufacturing organizations. Robots started working in Japanese companies in 1969 and they became increasingly important in industry as the number of Japanese companies using them nearly doubled each year from 1975 and 1981 [6]. Unfortunately, the number of safety issues associated with their use also grew. In 1983, the Japanese Ministry of Labor reported 48 recorded accidents involving human workers and robots, which represents a high fatality ratio when compared to most common occupational situations. Further, robots have been credited with causing deaths when humans got too close to them [10].

To enhance robotic safety, Hamilton and Hancock [6] recommended proximity sensing systems and exclusion mechanisms. Proximity sensing systems are designed to prevent robots from coming in contact with humans. Exclusion mechanisms reduce the likelihood of humans being harmed by preventing them from entering locations where robots are operating. Amazon has put fencing around the robots in its fulfilment centers to keep its employees safe, as well as to improve the efficiency of its operations [11]. Amazon also equips its employees with a bright orange Robotic Safety Vest with embedded sensors. The robots can detect when a human is nearby and either slow down or stop entirely depending on the employee's proximity (ibid). In another example, the owner of Dynamics (the mold manufacturer mentioned above) subjected himself to a collision with a robot in his plant to estimate the potential harm to employees. The robot was purchased and installed only after passing the owner's safety test [8].

The misuse of robotic technology can also constitute a dark side - one that can lead to death. The Da Vinci robot, a minimally invasive robotic surgery system, has many merits: It facilitates greater precision in surgical incisions and it offers superior views of the patient's surgery site, especially because there is less blood to obscure the vision. On the dark side, innovative robotic technologies have been blamed for patients' deaths in recent years [18]. Probably the most publicized was the death of a Chicago man in 2007. Unfortunately, a surgeon punctured the patient's spleen when operating a $1.8 million Da Vinci "hands-on" robot surgical robotic system for the first time on a living person.

A Saunders, Rutkowski, Pluyter & Spanjers [19] article published in the interdisciplinary journal, Journal of the Association for Information Science and Technology, suggests five hazards that are prevalent in such tragedies: (i) overloaded or underloaded Operating Room (OR) professionals, (ii) inadequate surgeon training on the robotic systems, (iii) inadequate training for the healthcare professionals on the surgical team, (iv) the complexity of Health Information Technologies (HITs), and (v) overconfident surgeons. To avoid these hazards, they argue for adequate training of healthcare professionals accompanied by a certification of mastery of use of the technology upon completion of the training. Since surgical robots are not fully automated, their use depends on how well a surgeon is trained in operating with them. Surgeons need to learn how to make sense of the clear and detailed 3D images the systems provide, and to employ the semi-automated robot as an extension of their human body. That is, the surgeon's performance depends on the control of the robotic system using the haptic (force and tactile) feedback received from the system while they are operating. In the context of the OR, not only the surgeons, but also the whole team has to be trained to cope with adverse events. Publications in the medical field report on the potential of realistic Crew Resource Management programs to train surgeons and medical teams in dealing with distractions [20]. Also commonly used in the military and aviation industries, CRM programs are simulation-based and provide training for technical skills, as well as non-technical skills such as communication and teamwork.

A good example of robotics research is a recent study by Sergeeva, Huysman and Faraj [21]. Sergeeva and colleagues spent over 100 hours observing the challenges surgeons and surgical teams face when learning to operate the Da Vinci robotic system. In one OR emergency situation, Sergeeva et al. observed the anesthesiologist crawling under the table upon which the patient was resting in order to reinsert a breathing tube that had fallen out of the patient's mouth. Their research, like ours, suggests that operating, or co-operating, with the robotic systems can be dangerous and the entire team needs to be trained to provide coordinated responses to unanticipated problems. It is important to realize that robots can be operated by humans, but are mostly led by software.

Self-driving cars are distant from our classical anthropomorphic vision of robots. However, they drive and make decisions using operating systems similar to those used by automated pilots in planes and by many robots. The software and AI become the mind of the non-human entity. As reported in IEEE software journals, software is not free of defects and good software development practices are lacking. This can be lethal for airplane (Boeing 737 Max) or self-driving vehicle (Tesla) passengers. For example, software misinterpreting external inputs such as distinguishing a large white 18-wheel truck and trailer crossing the highway against a bright spring sky is a deadly example of recurrent issue in safety-critical system failures [22].

While some argue that robots are net job creators, others are concerned that they will be net destroyers of jobs. When canvassed in a survey, the split was pretty even across respondents holding these two positions - though respondents voted slightly in favor of a net gain in jobs (52%) versus a net loss in jobs (48%) [17]. Those concerned about a net loss stated that the trend toward replacing workers with robots to generate labor saving, and gains in efficiency will only accelerate. While white collar jobs may be affected, the biggest impact will be on blue- and pink-collar jobs. For example, Southern Glazer's Wine and Spirits LLC plans to ultimately replace the blue-collar workers in its Leesburg distribution center with robots [12]. As a result, on a societal scale there will be greater inequalities between highly skilled workers and others, as well as the deskilling of many jobs. The consequences may yield a permanent underclass [17].

2.3 Possible Research Areas on Robotic Technology

The IS discipline has demonstrated interdisciplinary expertise across a broad range of research areas. Working in teams, human-computer interactions, design of safety-critical systems, IS economics, technological innovation, and ethics related to technology are just a few. We can apply this expertise to research on robotic technology.

Our decades-long research on group support systems and virtual teams might help answer questions like these: How can industrial teams effectively incorporate robotic technology into their operations on the plant floor? How can humans learn to trust their 'cobots'? How does the presence of 'cobots' affect communications of human members of industrial teams? How can we train surgical teams to work more effectively with medical robotics systems?

IS research on human-computer interactions and the design of safety-critical systems could inform the design of robots. In particular, it could provide insights about how robots could be designed to best accomplish a specified function, what design can best enhance human-robot interaction or how robots should be designed as safety-critical systems. What level of control do we want to give to robots? What are the legal and economic consequences of malfunctioning robots causing harm for a company or a user? How much emotion should a robot be equipped with? Who should control the robot?

Further, research on technological innovation and IS economics could provide insights about how organizations should go about deciding whether or not to adopt robotic systems (especially given the cost of cheap labor), how to implement them successfully, and which challenges to anticipate during the implementation. Research also could address how we should rethink the concept of work or how can our public institutions (especially educational institutions) be prepared for the wave of change due to robotics? What role does bounded automation [13] play in the use of robots? What are the economic consequences of work substitution?

An area that IS researchers are starting to explore more fully is that of ethical issues. The use of robotic systems offers an opportunity for venturing even further in these explorations. The use of a cuddly small seal-like robot called PARO to console elderly Japanese residents of nursing homes even offers some possibilities for study. Ethicist and philosophy professor Sharon Vallor has raised an ethical issue about PARO replacing caregivers: "My question is what happens to us, what happens to our moral character and our virtues in a world where we increasingly have more and more opportunities to transfer our responsibilities for caring for others, to robots?" [23, p. 124]. Ethical issues related to robots are more obvious in the case when the driver in a self-driving Tesla was killed [24]. Should the robot be blamed? Will robots have legal rights? Since the self-driving Tesla is not 'human,' it is more likely that the car company or the software developers will be blamed. Even more nuanced ethical decisions might need to be reflected in software design. As Rutkowski and Saunders [23, p. 124] note: "If a human is in command, he will be blamed for making the wrong decision. If the robot is in command, the software developer likely will be blamed. Some believe that having the most perfect algorithms is always superior to human information processing; Others say that it is just about enforcing more legal regulations on developers." Still another aspect of ethics as it relates to robotics systems focuses on the marginalization of workers replaced by the technology. Who, if anyone, should be responsible for training them or otherwise finding a viable place for them in our society? What mechanisms (i.e., workers' councils, unions) can help protect the workers in the face of robotic technology? Clearly there are a lot of ethical issues for IS researchers to explore.

3. IT Addiction[1]

Another topic that is under-researched by IS researchers is IT addiction. The term "addiction" has a negative connotation. It is commonly related to substance abuse impacting brain functions and, therefore, behaviors. Mainstream psychology and mental health journals primarily view addiction through the neurophysiological lens of the Brain Reward System (BRS). The BRS is a complex cerebral circuit engaging specific neuronal pathways that are modulated by cortical oversight systems affiliated with emotion, memory, judgment and decision making. The BRS is extremely responsive to positive and negative reinforcements, which helps explain the phenomena of addiction in both animals and humans [25]. By IT addiction we mean "the state of being challenged in balancing IT usage mindfully so as to preserve one's resources [and] includes Internet, mobile email, and SNS addictions" [23, 137]. Consequently, IT addiction is mostly associated with excessive Internet sessions (i.e., abuse) and the experience of distress when mobile phone connectivity is lost (i.e., the emotional and behavioral consequences). However, IT addiction is currently not one of the mental disorders listed in the latest Diagnostic and Statistical Manual of Mental Disorders (DSM-V). Most psychiatrists and psychologists believe that a common set of symptoms and diagnosis criteria are missing to include it [26]. However, most converge on the idea that the lack of control consciously exerted by the brain on its reward system contributes heavily to IT addiction [27].

3.1 Only a Dark Side for IT Addiction

All generations are staying connected too long on Internet and Communication Technologies (ICT), which is causing a range of dysfunctional behaviors. These behaviors, which are related to IT addiction, are often turned into buzz words or acronyms such as FOMO (Fear Of Missing Out), iDisorder, or more recently Nomophobia (No-Mobil-Phone-Phobia) in the popular press. Nowadays, "being FOMO " or declaring oneself as a "nomophobe" is "voghish", not to say socially desirable. Some acronyms have been scientifically addressed; others have not been fully addressed yet. For example, Fear Of Missing Out (FOMO) is defined as "a form of social anxiety—a compulsive concern that one might miss an opportunity for social interaction, a novel experience, or some other satisfying event aroused by posts seen on social media sites" [28, p. 69]. Nomophobia[2] relates to the phobia of being out of cellular phone contact, but has no standardized definition yet. Before these fashionable acronyms flourished on the web, scientific research has found that 58 per cent of adults and 68 per cent of young adults checked their phones more than once an hour; 73 per cent panicked when they misplaced devices; 14 percent felt desperate and 7 per cent became physically sick when their smartphone went missing [29]. Two decades ago, Kandell [30, p.11] characterized psychological dependence on the Internet as: "(a) an increasing investment of resources on Internet-related activities; (b) unpleasant feelings (e.g., anxiety, depression, emptiness) when offline; (c) an increasing tolerance to the effects of being online; and (d) denial of the problematic behaviors." Also, research demonstrates that excessive smartphones usage can lead to unreasonable preoccupation with the device as well as frustration and anger when interrupted [26]; It also can lead to Attention Deficit Hyperactivity Disorder (ADHD), depression, and social phobia in millennials [31]. In summary, users across generations find it hard to unplug, and they suffer serious consequences as a result.

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[1] For a more detailed discussion of the BRS and IT addiction, please see our book "Emotional and Cognitive Overload: The Dark Side of Information Technology".

[2] https://en.wikipedia.org/wiki/Nomophobia (downloaded 5/25/2019).

The early work of Davis [27] is particularly relevant in understanding phenomena such as FOMO, nomophobia or internet bulimia. Davis proposed a cognitive-behavioral approach to IT addiction which he defined as Pathological Internet Use (PIU). PIU is defined as the negative consequences of problematic cognition coupled with behavior that intensifies or maintains maladaptive responses [27]. Davis [27] identified two distinct forms of PIU: specific (i.e., overuse or abuse of content specific functions of the Internet as an underlying element of broader behavioral disorders) and generalized (i.e., a multidimensional pathological overuse of the Internet itself due to the unique communicative context of the Internet). Overall, PIU behaviors are considered specific when an individual is predisposed to develop maladaptive usage through a pre-existing pathology and becomes dependent on a particular Internet function such as online auction services, sexual material/services, or gambling. PIU is considered general when the Internet is overused such as when people spend time online because they are bored or feeling lonely (see [32]), or when they develop problems due to the interpersonal contexts available online (see Caplan [33; 34; 35]). This multidimensional pathological overuse/misuse can result in deleterious personal and professional consequences. But whether it is called IT addiction, Internet addiction, FOMO, nomophobia or PIU, it is a force to be dealt with in our society.

3.2 Possible Research Areas and Measures Related to IT Addiction

Most studies of IT addiction have been conducted using a behaviorist perspective. It may be worthwhile to adopt a cognitivist-emotional perspective, as well as to employ neurophysiological tools, to study, for example, BRS in conjunction with general PIU (i.e., see [36]). Notably, neurohormones such as dopamine and oxytocin (the 'love hormone') are heavily involved in activating BRS mechanisms. Brain activation and a focus on attachments are surely interesting constructs when considering the abuse of social media such as Facebook or Instagram. Nomophobia and FOMO may be modern forms of Not to Be Missed Phobia (No2BMphobia) or Fear to Be Alone (F2BA), rather than a love of smartphones or connectivity. These phenomena are not to be confused with one another and warrant more research. Some possible research questions include: What causes over-connectivity on smartphones? As a result of Social Network Systems (SNS) technology's primary function to link us to loved ones, does the brain become inundated with oxytocin and, consequently, is general PIU likely to occur? To what extent does continued use of social media reinforce BRS and create situations of general PIU? To what extent do SNS extrinsic rewards such as status, number of likes, and positive comments lead to difficulties in disconnecting from Facebook? How is specific PIU related to serious underlying elements of mental disorders and personality disorders (e.g., narcissist personality disorder, social phobia)? How can SNS and mobile phone technologies be designed to reduce IT addiction? What types of alerts can be created to warn of the imminent possibility of IT addiction?

Answering these questions will require a multi-disciplinary approach involving mental health specialists (e.,g. psychiatrists, psychologists) and possibly neuroIS scientists to interpret fMRIs showing what portion of the brain is activated when dysfunctional behaviors are displayed. Our field has always been interdisciplinary and willing to work across multiple disciplines. For this reason, IS researchers are in an excellent position to initiate the multi-disciplinary research needed to answer the questions raised above.

Finally, the time spent on the Internet or being connected is not in itself a symptom of addiction [29; 37] or PIU [38], but rather its precursor. In the past, measuring actual usage time online or on the device has proven problematic, and most research fails to reflect accurately users' task-switching/multitasking behaviors. Research has demonstrated that measures of usage relying on the self-reported hours and minutes users estimated that they had accessed Facebook, Twitter, and their e-mail differed significantly from the actual time monitored with software installed on their computers [37]. For example, while users self-reported spending an average of 149 min per day accessing Facebook on their computer, the actual average time, according to the monitoring software, was 26 minutes per day. To properly assess IT usage and its impact on IT addiction, new measurement scales must be developed and validated (see the Media and Technology Usage and Attitudes Scale by Rosen et al. [29]). Further, self-reported data can be complemented with physiological markers collected through a range of sensors available on simple devices such as watches or armbands (e.g., SenseWear Pro 3 armband). A new challenge is to design methodological tools to capture a more complete, holistic and conceptual portrayal of IT addiction and its precursors (i.e., triangulation).

4. Conclusion

There is clearly some interesting research being conducted on Robotics and IT Addiction. However, that research is not being published in Information Systems Journals and, for the most part, it is not being conducted by IS researchers. Why not? The phenomena clearly have huge potential impact on individuals, industry and society. Studies of these phenomena could benefit from the expertise and involvement of IS researchers. It appears that these topics may offer a golden opportunity for IS researchers. We urge them: Go for it!

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