UPPSALA UNIVERSITET

Report for 1MD017

Literature Study

Group 09

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Introduction

This Literature study aims to summarize and critically analyze Kim Vicente's book : "The Human Factor". The summary covers the author's thoughts and message about how technology and systems should be designed, keeping in mind human capabilities and interactions. The critical analysis part has thoughts of the group members on the parts of the book that they read. The group had 5 members and each of them contributed to this study. Deman covered Chapter 1 and 2 which talk about how technology has gone out of control. Hamza covered chapter 3 an 10. Chapter 3 talks about the physical factors and Chapter 10 talks about how future technological advancement should be approached. Chapter 4 and 5 were covered by Areeb Asad and talk about the psychological aspects of technology. Chapters 6 and 7 were covered by Christroffer and talked about teams and organizational issues and their resolutions. Rafay covered Chapter 8 and 9 which talk about political imperatives and how they should be approached.

Summary

Part 1

A Threat To Our Quality Of Life: Technology Beyond Our Control

The human factor by Kim Vicente is about the role of technology in society; primarily ergonomic design, which means the process of designing systems to fit the users. He describes exceptionally well the importance and the need for work analysis before designing systems. Throughout the whole book, he narrates with the help of examples how complex systems can be lethal and significantly contributes to human error. In addition, he uses these examples to show how the human-tech-ladder is affected. The ladder starts with physical and progresses to psychological, team, organizational and political needs. In part one, we read about the incident that happened on April 25, 1986; the Chernobyl accident which had grave consequences. On that day one of the plant's reactors was run down for annual maintenance and was not in regular operation. While working with various experiments, the usual safety procedures were not followed, resulting in the reactor being out of control. Eventually, the roof of the reactor was blown away followed by an explosion hence leading to radioactive emission. Apart from the countless people who lost their lives and many who suffered because of the exposure to the high level of radiation, the environment was also contaminated and to date, the land cannot be used for agriculture purposes. According to Vicente, this accident would have been avoided if the designers paid attention to human factors. Although the operators were trained, it was the complexity of the system that led to their downfall. Another incident which shows that complex systems can cause complications and confusion is the electronic oil-checking gizmo. This so-called 'simple' system which was supposed to make it easier for drivers to check their oil electronically from the driver's seat

proved to be complex and inefficient due to the meaningless numerous steps. It is evident that the designers did not think about the fact that drivers will eventually go back to the old method since the new technology came with unnecessary steps that might be hard to remember.

The impact of technology on medical professional was also among the examples discussed. He defines technology in a broader sense which according to him include not just the physical but also the non-physical stuff that can be found in complex technological systems such as work schedules, information and team responsibilities. He felt that there was a need to include non-physical stuff because not only is it a relevant factor but also the fact that it has led to many life-threatening accidents and death. For example, In the case of Libby, who went to the hospital because she had a high fever and died a day later. The cause of her death was because the nurse who was sleep deprived was negligent, it was an adverse reaction between two medications that caused her death. A death that could have been prevented if the nurse had paid attention to her work. Although the nurse was negligent, Vicente points out that the cause was, in fact, the non-physical part of technology. It happened at a time where these factors were not considered and therefore nurses worked up to 120 hours per week. In that kind of working condition, mistakes are inevitable. While our obsession with technology continues to grow, we tend to overlook the importance of human interaction. The incident with the ambulance is one of many evidence why the human factor cannot be ignored. In this case, the computer algorithm which was supposed to be totally automated was not doing a good job of assigning ambulances to calls. The overly ambitious information system which was designed to minimize human involvement had the opposite effect. As a result, Twenty to thirty people were reported dead. Clearly, the designer did not consider the need for human interaction with the system as a backup plan.

Part 2

Chapter 3: Let's Get Physical: Fitting the Design to the Body

In chapter 3, Kim Vicente talks about the lowest level in his "ladder", which is the physical level. The author states that one of the aims of designers is to create things that are a good fit with human physical characteristics. People do have different shapes, sizes, level of strength and skills but in the context of any design, a lot of the prospective users will share the same physical constraints and capabilities. As a result, the author argues that when designing anything that is intended for the use by people, the objective of the Human-tech approach is to design in such a way that these physical capabilities and constraints are taken into account so that the product is easily usable by the people it is intended for. As an example, the author talks about how the design should take into account the context and says "If we're creating a product for children, the design shouldn't require them to reach two metres above the ground, because children can't reach that high". An important point Vicente raises is that the physical

level informs us about the constraints and capabilities of humans and looking at already developed products in the physical "ladder" context can identify and prevent recurring physical problems.

The author states that the human body has many different aspects and features and when designing for humans, in the physical sense, there are a lot of characteristics that have to be taken into account to make the design "fit" the human body. Humans don't tend to think about these diverse characteristics and capabilities that the human body has and instead focus on the tasks that they have to perform. Whenever something exceeds a particular person's capacity, for example not able to use an awkwardly shaped tool, humans tend to blame themselves, i.e blame their lack of skills in using the tool ("human error"), instead of realizing that the flaw may be due to the design. The author argues that in many cases the fault lies with the fact that technology hasn't been designed to fit the human bodies because Human-tech approach is not taken.

Kim Vicente believes that there is so much knowledge available about the human body, as he says when talking specifically about human hands "there is more information available about human hands than you will ever need or care to know about", that designers should be making products that perfectly fit the capabilities of the body. He illustrates with the help of examples that in many cases, this is simple and sensible assumption does not hold. The reason for this, according to the author, is that in strictly technical terms the product might be a state of the art design which has taken into account all the technical details but because this Mechanistic perspective leaves the human factor out of the design, the product is less "useful" for humans than it would be if the Human-tech approach would be considered.

The author further argues that damage caused by this Mechanistic way of developing tools and products can be realized when you think about it in terms of industries or products where mistakes on part of humans can cause catastrophes, such as the Aviation Industry or Nuclear Power plants. An example is how Alphonse Chapanis used the Human-tech perspective to figure out why pilots kept retracting the landing gear after landing certain models of aircraft in 1943. Chapanis concluded that there was a design flaw and and used the Human-tech approach to modify the design, which eliminated the problem. This showed that designs that consider the human factor considerably increase safety in such critical environments.

Chapter 4 and 5: Minding the Mind I: Everyday Psychology

In chapter 4 and 5, Kim Vicente talks about the second level in his "ladder", which is the psychological level. The author reveals a completely different perspective, where human nature is considered while designing products or systems, as it leads to more closer bond between people and technology. The author

discusses the psychological challenges forced by the the today's technology. According to author, apart from taking physical constraints into account while designing, one should also consider psychological constraints/properties of people to achieve Human-Tech design. Moreover, as nowadays, electronic devices are used by people throughout the day, one should realize the importance of human psychology factor, while designing of everyday products or services that only adjusts with our body but not our psyche. The author states several psychological properties and design principles such as limited capacity, cause-effect relationship and feedback mechanism, that Human-Tech design should take into consideration. To explain, the author discuses his opinions and defends them with supporting evidence by giving several examples related to aviation industry, day-to-day consumer products, health-care-systems and safety critical systems.

Firstly, the author discusses about one of the psychological constraints i.e the limited capacity of human minds. According to writer, a technology must not be designed in a way that puts too much burden on the limited capacity of humans mind as it causes mental stress and makes it difficult for humans to use it. As an example, the author explains an automated phone message system, in which the system has replaced human beings making the process convenient at physical level but at the same time it's psychologically challenging for the customers due to multiple levels in the call and as a result, customers has to remember the sequence of numbers or different paths to reach the desired service. The author argues that the systems is technically perfect but only accounts mechanistic view and does not considers human factors. Secondly, he talks about the cause-effect relationship, in which one event has an effect on another event. He explained it by discussing four-burner problem, in which all the knobs are horizontally placed without marking, which makes it difficult for user to know that which knob represents which burner on the stove. According to Kim, this design is not easy to understand, use and grasp psychologically as it violates the cause-effect relationship. Thirdly, Kim emphasizes on the importance of feedback design principle and discuses its relationship with the technology. Feedback plays vital role in human psychology as it reflects human thinking on the current situation as per the provided information. The writer illustrated it with several examples, one of them was of fire, that if people try to touch it, they get feedback in terms of heat and as a result they can back-off in time. Better products can be made by using these design principles. Furthermore, the author relates the psychological capabilities and limitation with respect to safety-critical systems, where a single mistake can lead to disastrous situation and thus emphasizes the need to consider Human-Tech designs principles in these systems.

Chapter 6 and 7: Teams and organizations

In chapter six Vicente discusses the importance of teamwork, and draws on a lot of examples from the aviation industry. Where they went through a significant evolution where they went from promoting the "flight Ace" who could do it all, but wasn't that adept at working in a team, to make teamwork training mandatory to in essence create highly functioning teams. In contrast, the mandatory

teamwork training developed for the aviation industry (Cockpit Resource Management), similar training program was developed for the training of medical professionals, specifically anesthesiologists, but has since evolved to cover more specialties. However, this system has not been made mandatory and one could argue this has more to do with public relations than anything else, but that's just my opinion and not that of the author.

In chapter 7 the discussion is moved from the team to the organization and the author discusses events leading to the Challenger launch that sadly lead to the loss of life, after the engineers from both NASA and Mothon Thiokol, the firm that designed part of the shuttle were overruled by a group of managers. The problem was basically that the burden of proof had shifted, the engineers had to prove it was unsafe to launch and not the opposite as it had been before. Sadly this was not noticed by the organization. Further examples consist of changes in organizations that do not punish staff for reporting problems and near-misses, instead reward the whistle-blowers since their efforts can give an insight in organizational or other problems that can result in serious events and potentially loss of life. Also, when more light is shunned on problems they are harder to hide, thus making the organization more transparent to the benefit of all. The most prominent example of this is the Veteran's Administration hospital in Lexington, Kentucky even going as far as informing patients of their families of the facts, and explain what has been done to prevent similar mistakes. They also help them seek financial retribution. This level of transparency is rare, but I can imagine the benefits to both the patients and the staff. Instead of the usual (in my opinion) procedure of no one taking responsibility, it is very clear that the hospital is at fault and make owning the mistake and clearly show that they want to improve they have created a culture of honesty and trust.

Chapter 8 and 9: Political Imperatives

Chapter 8 and 9 are about relationship between politics and technology. The political needs of the day always take advantage from the possibilities offered by the technology. The technology is always invented to serve a certain purpose, but it could also be used to serve a political purpose for which it is not intended for, and this sort of use of technology inside politics is known as "bottom-up" approach. The writer tried to illustrate this approach through four examples. 9/11 was the worst incident happened in USA, but if we take some facts into account, we can safely say that an airplane can be a safe mode of transportation, but it could also be a weapon of mass destruction. Punch card machine was very useful tool to conduct census back around 100 years ago, but it was used in the campaign of genocide by Hitler and his company. Video camera is a useful technology in terms of capturing the events going around, it could be used in the campaign against human rights violations, but it can also be used in pornography. Internet can be used to spread the words against human rights violations and it can also be used to manipulate facts of an incident happened as a result of human rights violation. There is a wise saying: "Why waste your own resources when you can use those of your enemy?".

Here it is necessary to mention that technology itself is value neutral, its neither good nor bad. Here comes a concept of Human-tech thinking into account. Human-tech thinking recognizes the fit with human nature at a political level which could be used for oppressive purposes but on the other hand it can be used to advance human values. The countries where there is democratic form of government, politics is something limited advocacy, voting, open debate etc. but in the countries where there is some sort of dictatorship the politics is quite different, so the human-tech thinking is also different.

Then there is a top-down approach, in which decisions are made deliberately at the political or organizational level to ensure safe and effective use of complex technological systems but with the wrong decisions being taken at some point can make things go around. The chapter 9 is related to the same approach.

To make the political system design useful and effective the first thing is to make it tailored with changing human nature from time to time.The main objective is to satisfy a human or societal need. Designing a system requires some sort of certainty, but when it comes to human nature, predictability is the other problem. Since predicting human political behavior is difficult it makes the system design a lot more complex. Tailoring the design of a system to human nature is an immense challenge at the political level, for example predicting if a new public policy will be well received by the voters is always uncertain.

Researchers has identified three levers to predict human political behavior. Those are; policy aims, legal regulations and budget allocations. Policy aims represent value judgments and thus its most important parameter, so it is also called mother of all political systems designs. Legal regulations are also important as if we see, in case of health care legal liability can bound a doctor and could result in a death by medical error. It can be said that if policy aim is a compass, then legal regulation is an engine that powers complex technological system in the desired location and budget provides fuel to run the system smoothly.

Part 3

Chapter 10

In chapter 10, the author emphasizes the need to adopt Human Tech thinking so that any risks and catastrophes as a result of technical advancement can be mitigated and technology serves human interests in a better way. Technological advancement has brought a lot of benefits to humans but Kim Vicente believes that to truly have technologies and systems that are safe and serve human needs, the Machinist and Humanist views on developing technology and systems have to be replaced by the Human tech view. The author believes adopting human tech thinking in organizations and educational institutions (focusing on teaching human tech approaches to engineers) would improve technology and help avoid disasters such as Chernobyl.

Another important point raised by the author is the fact that human tech thinking and context matters. Differences in people, literacy rates, social structures and ability to utilize technology can make a technologically advanced gadget that is popular and extremely useful in one area of the world, totally useless in another. To avoid this, context has to be considered and a human tech view can give a better picture to people creating the technology so that the focus can be on developing things that will be useful.

The author believes that the time for a human tech revolution has arrived and urges readers to try to take part in it. The revolution, according to Vicente, will help us create technology and systems that are close to human nature and that would in turn bring positive change on a global level and reduce catastrophes such as air crashes, public health epidemics and nuclear power plant accidents.

Critical Review

Part 1

Overall, Vicente emphasizes the designing process of large-scale technological systems and how important it is to study and involve the user in the process so as to avoid the complications that are brought about by the demand to adapt to new complex systems. He urges developers to identify the human factors which are central to the technological world and then fulfill those needs by tailoring technology. It is an eye-opener to developers who usually tend to overlook users when designing and creating systems.

Part 2

Chapter 3

The author talks about how designs, physically, usually take into account the Machinist view because the focus is on the product being technically superior and argues with examples about how human-tech view would improve such products. The good thing about this is that the author not only analyses and gives examples about products that had a "bad design" (e.g the mechanical lathe) but also talks about products that were successful and had a "good design" e.g (the Fender Stratocaster). One thing that could be deemed missing though is the fact that the examples of "good design" have details about why and how it was a good design and the process followed but the "bad design" examples do not have these details and does not mention the process that was taken to design them. Overall, the author makes a clear point and is able to show using examples that human-tech thinking can indeed make better and more "useful" designs.

Chapter 4 and 5

The author in a series of subtle examples, indicates that psychology plays an important role in designing products or services with Human-Tech approach. The author discussed psychological challenges forced by today's technology. The approach taken by the author pushes one to think out of the box. The examples given by author opens up the mind and urges one to see a whole new perspective which is often ignored. In my opinion, inevitably, several crucial questions are left unanswered in these chapters. What to prefer?: psychologically fit designs or cost-effective solutions. Overall this book is an analytical look at human nature while designing tech products or services, which within the field of Human Computer Interaction is often overlooked.

Chapter 6 and 7

By using examples most of us can relate to the author lets you see things from his perspective, in essence, take a dive into his mind and reasoning, this, in my opinion, is crucial to be able to see the authors point of view. Most of the point the author makes are, in my opinion, valid and I feel as I can relate to the examples he gives both in a manner och imagination and also in a professional matter having been working in various fields as a developer. What I found amusing and so obvious was the notion that if you reward whistleblowing you get a safer environment for both staff at patients. A parallel can be drawn to software development if you encourage people to speak out when they find problems or issues, they will have to be addressed, as it is right now (in my experience), things are left as is which can be troublesome. Since there is a fear of being that guy that outed his colleagues for not doing their best at every turn. Which actually made me think, what are our actual responsibilities towards our employer. I can personally say that my I think of this very different now as opposed to 5 years ago mostly due to that I and a couple of friends started our own business.

Another thought sparked by the author was my own approach to teamwork and what it actually entails. Not as in how people are grouped together but how we expect them to finish a task at an allotted time, seldom a time of their own choosing. As now during this group assignment, how can we in advance say that we expect you to accomplish this task in this amount of time? Since we differ a lot in how much time we can spend on a given course depending on workloads from other courses and/or work and perhaps social and family life. Is the concept sound?

Chapter 8 and 9

If we talk about human-tech thinking limited to its political imperatives. Author has devised it into two approaches: The bottom-up approach and the top-down

approach. Technology being used by humans to fulfill their own political desires which has a bad impact on other humans is a bottom-up approach and technology built with policy aims to serve political objectives is a top-down approach. Considering the theory presented by the author in this part of the article; humans should be really worried about technological advancements in future and how are they going to affect the life of humans. Since, it's difficult to predict human's behavior, so usefulness of technology will remain under a question. Moreover, how political situation of world will go around, will also have a great impact on the political developments and ultimately on the human-tech approaches. At the higher level of world politics or some peace keeping organizations like UNO should consider having debates and making some international policies to ensure the world being a better place to live and improving human's quality life with the advancement of technology, instead of technology being used as a destructive tool.

Chapter 10

In the last chapter, the author summarizes his book and talks about how a human-tech revolution would increase safety and product "usefulness". Although the author makes convincing points, the fact is that there is still alot of work to be done before there could be a "human-tech revolution". Bad designs can impact alot of people but consumers are concerned with 'rapidly changing trends" and companies focus on that rather than getting the design close to "human nature". To successfully transform the way things are designed, campaigns which educate people have to take place and there has to be a political will to do it as well because for this to be successful companies and organizations would have to be pressured and compensated and both of these things would not be possible without having a political will to do it.