BRINGING A FULLER SOCIO-TECHNICAL PERSPECTIVE TO DESIGN DECISIONS

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Abstract

More often than not Designers and Design Engineers, tend to focus on Techno-physical aspects as they move through their design process. It is argued even the smallest and seemingly benign design decision, during the design process, may have a large and significant impact upon issues outside of the techno-physical focus [i.e. sustainability]. The paper will draw upon the idea within the technological change literature that it is not merely technologies advancing at and exponential rate but non-technical issues are increasing as well. There is a strong relationship between technology, society, and the environment. This paper will frame and discuss our need to educate future Designers/Design engineers to consider technical issues in parallel with larger issues generally considered to be outside the domain of Design / Design engineering. If we are able to find methods that assist both our present and future designers to become "Active Players" in seriously considering how we impact larger socio-cultural issues, which include notions of sustainability, we may embed a full/rich Socio-Technical Perspective within every aspect of our design decisions, and the outcomes we generate.

Keywords: Decision making, Design education, Sustainability

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1 INTRODUCTION

Industrial Designers and Design Engineers have a capacity to act as change agents within society. They may instigate positive or negative changes. These changes may determine if society moves forward in either a sustainable or unsustainable way. As suggested in Rosenman and Gero (1996) often the products systems and environments they develop help shape and indeed determine both the Techno-physical and Socio-cultural aspects of society. Moreover, they argue that these have a direct relationship with our natural environment. Consequently, there is a great potential to significantly impact our natural environment in either sustainable or unsustainable ways. According to Kurzweil (2005) technological change is increasing at an exponential rate. He argues we are going past Moore's law. In point of fact he argues technological change may indeed be growing at a double exponential rate. He is not alone in his assessment of the pace of technological change. In his work Schmidt (2008), notes that much of our past has been shaped by a number of complex convergences that had their beginnings as separate and independent lines of inquiry. Suggesting larger and indeed global systemic aspects are at play here. If we accept the view that technological change in the world within which we live and work is increasing at an exponential rate we may argue this in turn causes turbulent change within society, and indeed within social relationships. Consequently, as suggested earlier, in a real sense it is the designer and indeed design teams who act as change agents. When they design they make many considered decisions throughout their design process. More often than not they are Solution/Goal focused. Regretfully, in many instances this occurs at the expense of consideration for issues outside of the Techno-physical. Both now and into the future designers will need to be an "Active Player" in the process of seeing the "bigger" picture while they make their many considered and nuanced design decisions. They will need to be educated in how to practice this. They will need to alter their tools, methods, and thinking as they introduce even more change. This is especially true in direct relation to sustainability issues. From both a technical and human perspective they will need to be practiced in making connections and giving careful consideration to these two different perspectives throughout the design process. This is particularly true in the early conceptual phases of the design process. In the context of above, this paper will frame and discuss propositions of why and how we may educate our future Designers/Design engineers to not only consider the fine detailed technical issues in the development of new products, systems and environments, but also the great significance of early design decisions. Exercises are proposed allowing both present and future designers to become "Active Players" in seriously considering how they may impact larger socio-cultural issues, which include notions of sustainability, while still addressing the core Techno-physical issues.

2 MORE THAN TECHNOLOGY CHANGING

A review of the literature discussing technological change makes it clear technological change is not just about the technologies and patents increasing at an exponential rate, it is a number of other issues advancing at a similar rate [See: Girifalco (1991) ; Karamchedu (2005) ; Porter [et al.] (1980)]. Generally speaking, they discuss issues surrounding technological change that include the following: Economic – Psychological – Institutional/ Political – Social – Technological – Legal – Environmental – issues [in short, the acronym = EPISTLE]. It may be argued it is not just the exponential growth of technologies and our growth in understanding within the sciences we need to be concerned about, but it is also these larger socio-cultural EPISTLE issues that are dynamically interrelated, which must be embedded in the design processes of our future designers. The work of Shavinina and Ferrari (2004) are of the view that all human cultural advancements are built upon remarkable technological, scientific, educational and moral achievements of the human mind. If, as designers, we are to shape a sustainable world we need to rethink how we shape the thinking of our next generations of designers and design engineers. Our future designers must have the capacity, in terms tools and skills, to take into account the varied dynamic interrelationships emerging as a result of increasing technological change. Thereby assisting the world to move forward in sustainable ways. Borgman (1995), reminds us of the twin tasks of the designer as they relate to trusteeship [a responsibility to society] of designing products systems and environments and Artisanship [making things and making things work for people]. Fundamentally, this suggests a need for a designer to develop a deep understanding of the nature of technological change and indeed larger socio-cultural and systemic issues which include sustainability. When discussing issues relating to the earlier phases to the design process, the work of

Reid & Brentani (2004) suggests that while teams are important, a case can be made for the notion that individuals have a great deal of influence in these earlier conceptual design phases, as some individuals perform a boundary spanning function, at least with respect to discontinuous innovations.

Moreover, while the exponential growth of technology causes turbulent change within society, and indeed within social relationships, the collaborative relationships between individual designers within design teams, the relationships between various design teams, and the broader relationships with non-designers will not be immune to the turbulent changes in the future. While the work of Kokotovich (2007), proposed a way of working with and developing creative design teams in this technologically turbulent future, in a real sense it is the individual designers who may act as change agents. It is argued here the individual designer who is able to see the "big" picture and the fine details at the same time [seeing both the forest and the trees simultaneously, as it were] who will have the potential to influence significant positive sustainable impacts. A number of authors discuss the importance of the early conceptual phases of the desing process {for example see: Zhang & Doll (2001); Sandmeier et. al. (2004); Reinertsen (1999); Thomke & Fujimoto (2000)}. It should be noted that in the work of Lofthouse (2004) designers have a significant role to play in relation to what she terms Eco-design. In her study it is noted that more often than not a designer's "First Hunches" in their solution developments are drawn from their tacit knowledge. This suggests a less than strategic approach to environmental issues in the early phases of the design process. Additionally in her work she suggests there is a core roll for industrial designer at the more detailed operational end. To a certain extent this is true and to a larger extent it is argued here that the capacity for conceptualising the bigger picture issues are not as practiced as necessary in this exponentially changing world. In effect just changing the material on the back of a television set to a recyclable plastic does not offer the design student the opportunity to consider many of the larger sustainability issues confronting us today and into the future.

Returning to Epistle issues discussed earlier, it should be noted both the Environmental issues and the Technological issues are seen as of equal importance. Furthermore, the environmental issues are not just an afterthought. As indicated on the left hand side of Figure 1 below, all the core EPISTLE issues are dynamically interrelated. In addition, relationships between the past, present, and future need to be considered by the designer as well.

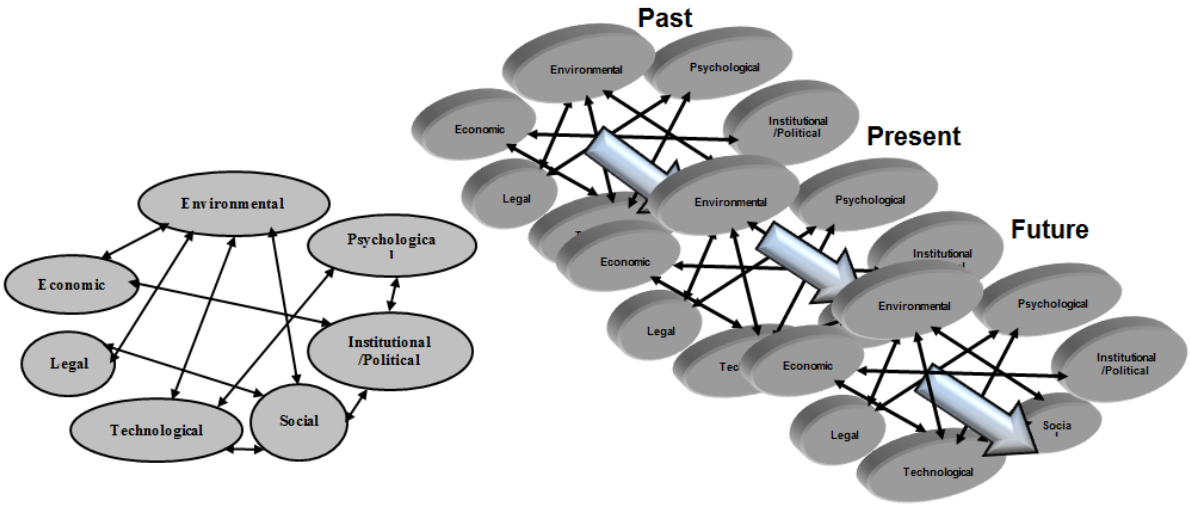


Figure 1. Dynamically interrelated EPISTLE issues

Since it is the early phases of the design process that relates to conceptualisation which sets the direction for the development of the embodiment phases of product design, the central focus here relates to issues surrounding creative idea generation and creative product conceptualisation. A position held by Gradwell (1999) argues an individual may determine future directions technology may follow owed in a large part to the enormity of technology and technical possibilities. He is not alone in this position. In point of fact when drawing upon the work of Ogburn (1956), a case is made by Roy & Cross (1975) arguing a single individual may have a huge impact and is able to reshape the

futures of societies. They discuss the power of an individual to shape society via the introduction of new technologies and innovations. They saw the individual operating within three dynamically interrelated contexts. The first was the technological environment. The second was the Biosphere environment. The third was the social environment. The strength of their argument rests on the exemplars they had given. They presented innovations that have had an impact. Moreover, the innovations were largely developed by individuals. They put forward the following innovations: Moulton and the bicycle; Cockerell with the hovercraft; Wankel with the rotary engine; Carlson with Xerography, and Gabor, Lieth and Upnatnieks with Holography. It was further posited even minor innovations such as the pen by Bic, or aerosol spray [which generally uses Freon as a propellant], and paper handkerchiefs had large impacts upon society. It can be argued these changes in technology brought with them concomitant changes in society that were related to the three main environments [Technological – Biosphere - Social].

It may be argued the development of the impact may depend on the design / problem solving approach embedded in the thought processes of the designer. The outcomes may largely be dependent upon if the Design thinking processes are End Goal/Solution focused ["small picture"] vs Problems/Relational Issues focused ["large picture"]. If the individual is solution focused and using a Positivist / Reductionist approach, as in science, it may be argued this perspective may lead to large negative environmental impacts.

3 ISSUES WITH A REDUCTIONIST PERSPECTIVE

It should be noted the Positivist / Reductionist approach of science has served us well for centuries, and indeed will continue to be an invaluable approach to addressing very detailed problems. However, it is argued here that this paradigm of thought has severe limitations when tackling large complex dynamically interrelated problems such as sustainability. Earlier discussions indicated that an individual designer may have great power to affect change through the development of innovative designs. Indeed it is argued seemingly simple "little" design decisions may have large and lasting impacts upon the environment. That is to say a small movement in the right direction may have a large and significant influence. The Italians characterise this as design primary where a single design decision makes a large impact.

The Italian "Design Primario" approach from the 1970's, as discussed in Celi (2014), considers sometimes a small movement in the right direction may have large influences. She is of the view this has opened a new and acknowledged field design for research within design disciplines. Specifically in relation to material design. Large design affects may happen at the nexus where materials used may bundle the various attributes of chromatic, acoustical, visual and surface properties to give the selected material its own identity. Clearly this approach to design focuses on the aesthetic and materiality "qualistic" "sensorial" attributes of design. This approach obviously shifts attention towards the soft quality of matter (i.e. color; light; sound; smell; texture). This approach to designing for cultural change balances the hard qualities, with those of formal structural composition. Moreover, the emphasis in on sensations, on physicality as an experience, and indeed upon communicating the values of materials utilised in the design. Consider a simple example of a large change that may occur if a small change is made to one simple local city regulation in relation to road construction materials. This may have a very large impact on the cityscape. Let us say that the new regulation requires that the roads be constructed using stone paving material. Additionally, all stone pavers are to be polished pink quartz. A sub-clause of the regulation is that a very specific pattern of the pavers is to be laid so that visually from above the pattern is unique and when driving down the road, at the posted speed limit, the tire "noise" of the vehicle causes a very specific "tune" or "melody" to be heard by the passengers. Consequently, miles and miles of the city roads are now made of polished pink quartz. Now when flying over the city, it takes on a new set "qualistic" "sensorial" attributes. The pattern of the roads are in stark visual contrast to the buildings as the glistening pink quartz reflects in the sunlight. Moreover, when driving on the roads the city "road music" is memorable to the travellers. This simple little scenario serves to demonstrate that one very small set of design decisions may have a very large impact.

However, while this is one simple hypothetical example let us turn our attention to a set of real examples that have had a large and lasting impact upon our environment. We may go back even further than the 1970's to the work of Midgley. Thomas Midgley was a gifted, creative, and innovative mechanical engineer and chemist. Over his lifetime he had won many prestigious awards He considered himself a "boundary spanner". Indeed he did not see boundaries in his work. In essence he was considered a problem solver and when tasked with a given problem he would tirelessly work towards the goal of a solution. In the annual meeting of the National Academy of Sciences Kettering (1947) presented a biographical memoir of Midgley's life work. Here we shall discuss two highlights of Midgley's work. In point of fact Kettering (1947 pg. 366) highlighted that Midgley would often remark "How can we overcome the difficulty and move ahead?" Clearly this is very suggestive that while being a boundary spanner Midgley had a very narrow Solution/Goal oriented design thinking process focusing on the minute details of the problem as given and did not think outside that frame.

Firstly, in the early days of the automobile, the engines were extremely susceptible to very noisy engine knock. At the time it was uncertain if the problem was owed to mechanical engine design, the chemical reactions owed to the chemical composition of the petrol, or some combination of both. Being the gifted mechanical engineer and chemist he was, he relentlessly worked until he found a workable solution that "solved" the initial problem as given. He found the problem lay with the nature of the chemical reaction of the fuel during ignition. He found that by adding Tetraethyl Lead to the fuel mixture this solved the "Engine Knock" problem. In addition it immensely increased engine performance in both automobile engines and airplane engines. After successfully establishing tetraethyl lead as in additive to gasoline Midgley turned his attention to the refrigeration. At that time the refrigeration industry was in dire need for a new and better refrigerant. More specifically they needed a new refrigerant for air-conditioning. The refrigerant must not be flammable, and should not have harmful effects on people who might be exposed to it, whereas ammonia-based refrigerants were harmful to humans and indeed the immediate environment. He surmised it had to be a *New* compound. Again turning this creative boundary spanning mind to the refrigerant problem he developed a workable solution. This solution was the development of dichlori-fluoromethane, commonly known as Freon. This was the first chlorofluorocarbon (CFC). This new compound has consistently been used in the refrigeration and air-conditioning industries ever since.

It is clear over time, the work of Thomas Midgley has had a significant impact upon the environment. The work of McNeil (2001) discussing environmental history remarked that Midgley had more impact on our environment than any other single person in Earth's history. As suggested earlier while being a "boundary spanner" Midgley had a very narrow Solution/Goal oriented design thinking process, focusing on the minute details of the problem as given, and did not think outside that frame. Owed to this very narrow frame of thinking and having a very focused goal oriented mind-set, we have today a number of complex issues we need to address in relation to a depleted ozone layer caused by CFCs, and high lead content in our atmosphere. It may be argued that if the creative design thinking process of Midgley was one that required him to consistently consider the dynamically interrelated EPISTLE issues throughout his design thinking process, different more environmentally sustainable solutions may have emerged. Moreover, the environmental issues we are wrestling with today may have been less significant than they currently are. This begs the question in shaping the new design thinking processes, tools, and strategies of our future designers and design engineers how may we educate them and shape their thinking to be more considered of the larger socio-cultural issues, the natural environment issues, all while addressing the fine detailed techno-physical issues presented to them. As suggested earlier if the individual designer is able to see the "big" picture and the fine details at the same time [seeing both the forest and the trees simultaneously] they will inevitably have the potential to influence our environment in positive sustainable ways. Consequently, it makes sense to discuss this idea in subsequent sections.

4 EDUCATING FOR SEEING THE FOREST AND THE TREES

Design education needs to change to a more holistic and inclusive approach in shaping the thinking of our future design students. This needs to occur as a matter of urgency, owed to the exponential growth of technological change. As highlighted above the thought processes of an individual designer/design

engineer has the potential to make significant impacts in our world. Moreover, again as indicated earlier as the artifacts designers develop become more advanced, there is an increasing need to make creative connections between diverse EPISTLE issues from a designerly perspective. This will clearly require a capacity for "seeing both the forest and the trees simultaneously". Essentially, the individual industrial designer/design engineer will need to alter their thinking and working strategies as they introduce even more technological change in the face of an ever increasingly complex future with increasingly complex systems.

Within the manmade environment artefacts are created in order to control and manipulate the physical world so human wants, needs, and desires can be accommodated. Introducing these artifacts can have serious consequence not unlike the impact made by Midgley's design decisions. As Borgmann (2001) warns the introduction of new artefacts can be a double edged sword. It should be noted that Designers who develop these artefacts may at times disregard larger issues, such as the environmental consequences. In his work discussing the dynamics of technological change Girifalco (1991) begins to clarify our understanding of Technological change. For our purposes we will define Technological change in terms of function. That is, change will be defined in terms of the means of performing a given technical task, fulfilling a certain need, or achieving a specific objective. This relates to both human and technical issues. This definition allows us to explore the issues of technological change in a larger context. In returning to Borgmann (2001) he argues that greater and greater levels of abstraction occur whenever increasing advances in technologies enter our lives. Consequently, in the future designers will need the capacity to operate at higher and higher levels of abstraction, in order to consider the more nuanced, complex, and dynamically interrelated issues confronting them. Consequently, this would suggest increasingly the burden of appropriateness of the technologies falls within the purview of the designer. It follows that designers need to be educated to accept their increasing responsibility. In his recent work, Middleton (2005) recognises the increasing importance of Values, Ethics, and Goodness within a Design and Technology education context.

While we argue a detailed understanding of the technologies and manufacturing processes is required, and this understanding remains necessary, additionally it can be argued these skill sets need to be placed in a larger context. Balance must be obtained between detailed technical knowledge and the big picture EPISTLE issues in generating artefacts based the introduction of new technologies and development of a detailed understanding of the contexts into which those new technologies and artefacts are introduced. That is to say the designer increasingly needs to understand the larger social cultural and environmental implications of the design decisions taken. In essence it is no longer just about having a product/solution focus anymore. It follows that if design students, and perhaps even science students, were introduced to issues beyond the artefacts they designed and how these artefacts dynamically interrelated with larger contexts, the artefacts they designed would lead to an increased capacity for developing a sustainable environment. In essence, technological change brings larger more complex changes with it. Therefore, it is not possible to focus only on the technical aspects. Additionally, technology is seen as being systemically diffused, with control being diffuse as well. The view of Gradwell (1999) suggests in reality technological policies have been determined in an ad hoc way, having been myopic by nature focusing on immediate choices and not considering a broader perspective. It is argued this is no longer a sustainable approach as we move into a more complex technically advanced future. This begs the question how may we shape our future thinking and indeed our thinking about the future? Let us reframe what may be the difference between Designed Futures in contrast to Future Designs.

Drawing upon the work of Jones (1970), in his discussions of methods, when looking closely at the design process, which includes planning of systems, their relationships products as well as products themselves to the components, the notes there is a relationship to the communities they operate within [big picture issues as it were]. As highlighted in the image of the left, in figure 2 below he notes the flow of the hierarchy moves from community level systems to a level products level and to the component level. However, this process generally may be considered devoid of a feedback loop in which the designer considers in detail how the design decisions at the micro level may impact the community [not unlike how Midgley, as discussed, earlier did not consider how lead in the air may affect the community]. Conversely, if we turn this on its head and reverse his perspective, as suggested

in the middle image in figure 2 below, we may consider that at times the designer, being creative and innovative, creates components and products which fit into systems which then are forced into societies and communities without detailed consideration of the larger impacts. However, it is argued here that if designers learn to extend their consideration and understanding of how their design decisions may impact the lager EPISTLE issues, as suggested in the image on the right in figure 2 below, more well considered and sustainable results should occur. Moreover, these designers should be required to consciously, consistently, and continually consider the EPISTLE issues when all design decisions are taken.

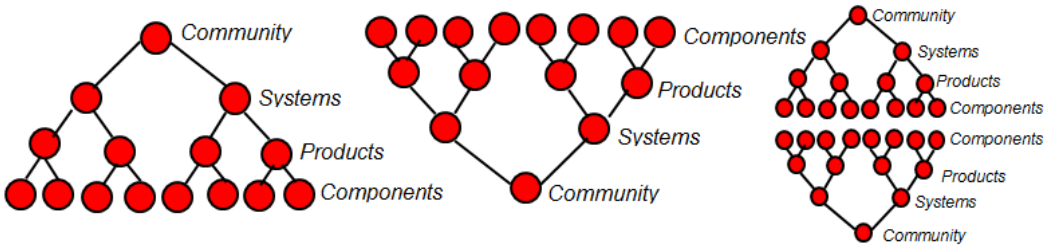


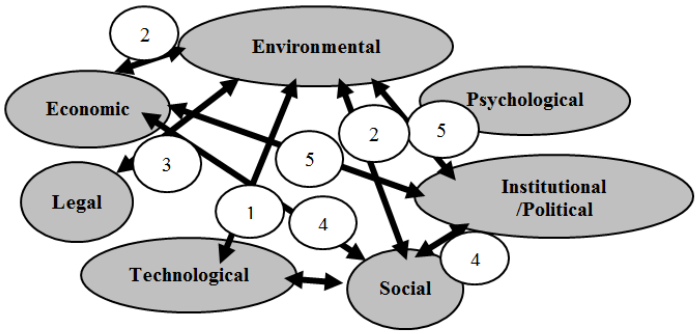
Figure 2. Flows of the Design process

This then begs the question what tools may we adapt to assist the designer in practicing this continual thought process? In essence we are seeking to assist present and future designers in becoming "Active Players" in the practice of conjoining larger socio-cultural issues [including sustainability issues], while still addressing the core Techno-physical issues. In drawing upon the work of Kokotovich (2008) and Kokotovich (2004) we may find some insights for a new way forward. While previous literature relating to technological change and EPISTLE issues treated the issues as checklists it has been argued here that they are dynamically interrelated. Consequently, a methodology is needed for allowing the student to graphically relate the issues. Drawing upon the work of constructivist educational theory and mind mapping techniques, Kokotovich (2004) regards Non-hierarchical mind mapping as a useful strategy for getting novice design students to map their thoughts and ideas in order to analyse design problems. Following on from this if the students were required to not only map their design decisions relating to what could be considered 'typical' design issues they could also map the EPISTLE issues as well. Let us draw upon and extend the example of Midgley's engine knock problem.

It should be noted according to Kokotovich (2008), during the mapping/analysis phase of the problem solving process embodiment is forestalled allowing a rich understanding of the problem space thereby enlarging the solution search space. Further, it is not difficult to see that while issues directly related to the detailed development of emergent technological design issues, EPISTLE/Technological change issues could be effortlessly included in the mapping exercise above. Alternatively, as suggested in Figure 3 below, students could be asked to develop a second mind map that would enable the educator to monitor each student's capacity for understanding the implications of the EPISTLE/technological change issues associated with their individual design decisions in relation to the development of their specific design solution for a given brief. As suggested earlier this should be done throughout the design entire design process. In this way the students become practiced in understanding the full impact of all their design decisions.

Let's turn our attention to mapping the engine knock problem using this tool. As part of the exercise we may start with considering a link between technology issues and environment issues, as in **Issue 1**, in Figure 3 below. Here the student may note and consider if we introduce Tetraethyl Lead to the fuel mixture to solve the "Engine Knock" problem, what harmful effects might the exhaust gas cause in the air, and indeed if the fuel with the lead additive is spilled into our waterways what affects would this have on the plant and animal life in our waterways. When considering **Issue 2**, it would be good to ask what are the issues surrounding the social impacts of a harmed environment and indeed the economic impacts of a harmed environment. When considering **Issue 3**, it may be important to know the legal implications of any effects the lead may have upon an individual handling the fuel. Will the lead affect their health giving rise to a law suit? When considering **Issue 4**, the designer may wish to understand

any economic implications as the new fuel is more efficient, people may use less of it forcing sales to go down and indeed government tax revenue may drop as well. When considering **Issue 5**, Is government regulation needed to protect a scarce natural resource?



Explanatory notes of issues:
[1] if we introduce Tetraethyl Lead to the fuel mixture to solve the "Engine Knock" problem, what harmful effects might the exhaust gas cause in the air, and indeed if the fuel with the lead additive is spilled into our waterways what affects would this have on the planet and animal life in our waterways **[2]** what are the issues surrounding the social impact of a harmed environment and indeed the economic impact of a harmed environment **[3]** what are the legal implications of any effects the lead may have upon individual handling the fuel. Will the lead affect their health? **[4]** economic implications as the new fuel is more efficient people may use less of it where sales go down and indeed tax revenue may drop as well.
[5] is government regulation needed to protect a scarce natural resource?

Figure 3. Sample1 " Engine Knock" - Non-hierarchical mind mapping exercise

While the issues highlighted above are but a few of the many issues which may need to be considered during the design development process, it can be seen that the "little" decisions throughout the development process may have follow on effects which go way beyond the simple solving of the engine knock issue. But what about some ostensibly simple, and on the surface seemingly benign, design proposal / problem. Returning to the notions of "Design Primario" and the quartz paving example, and using the Non-hierarchical mind mapping exercise it may be demonstrated that if we map and interrelate the larger Socio-cultural issues more considered and well resolved environmentally sustainable designs may emerge.

In the quartz paving example, let us imagine we are developing the map in figure 4 below. As part of this exercise [exercise 2] we may start with considering a link between technology issues and environment issues, as in **Issue 1**, [Figure 4 below]. Here the student may note and consider if we introduce the quartz paving into an rainy environment the gap material between the pavers may wash away causing runoff water to be less than pure as well as noting the pavers may become loose and rise up making for a dangerous road hazard. **Issue 2**, it would be good to ask what the issues are surrounding the social impacts of a very shiny road surface causing light to reflect in user's eyes and into buildings through the windows adding to heat load, driving electricity and air conditioning costs up. When considering **Issue 3**, if the roads have loose pavers the local city council may be legally liable for damages to vehicles and persons. **Issue 4**, if the city and it's roads become a tourist attraction, tourists trying the "Road Tune" may cause increased traffic, bringing economic prosperity to the city, but it may also affect the local society in negative ways. When considering **Issue 5**, while the quartz pavers may not wear out, is the government willing to bear the tax burden of continual road maintenance of dangerous loose pavers and adjusting the pavers so the "road tune" is maintained?

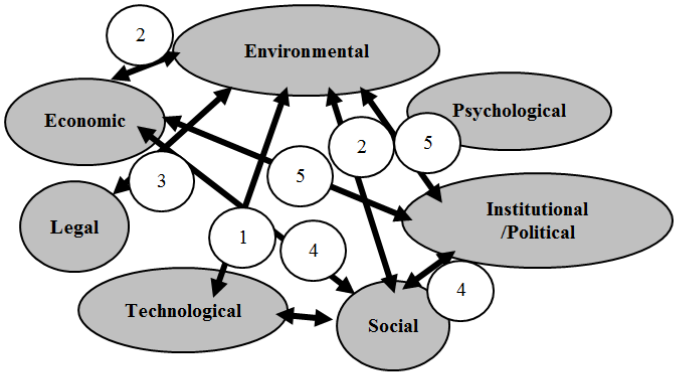


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Figure 4. Sample 2 "Pink Quartz Pavers" - Non-hierarchical mind mapping exercise

What is important in the exercise examples above is the idea that our design students and indeed professional designers alike should be using tools that assist them in developing the capacity to not only address the techno-physical issues but also the many many associated Epistle issues as well. Moreover, they need to do this in relation to all their proposals and indeed all their design decisions. Both our future and present designers / design engineers need to make evident the relationships between their proposals and the larger impacts they may have from a sustainable perspective and all it entails. However, while the mapping tool forms an important part of this, Kokotovich (2014) discussed a tool [a simple card game - The Frame Game"] which allows the designer to practice their capacity for seeing the "bigger" picture EPISTLE issues while developing their design decisions. Moreover, in that paper core underlying constructs within the domains of Design, Frame Theory, and Game theory were reviewed. It was a simple game with few rules, requiring players to use words - phrases – images – diagrams, forcing the random adoption of a non-design frame of reference in a dynamic way. As part of the gameplay the players are encouraged to adopt both a hard systems thinking and soft systems thinking approach as they strive to frame their thinking in terms of the technological change EPISTLE issues. Given the above it may be argued combining the tools of non-hierarchical mind mapping and the game ["The Frame Game"] our future generations of Designers / Design engineers, over time will not remain as tightly problem - solution focused as evidenced in the work of Thomas Midgley. Our future depends heavily upon the thought processes of our future designers and indeed how well considered they are.

5 CONCLUDING REMARKS

When Park (1975) was writing in relation to Earth's resources and man's future, he draws our attention to the disquieting mathematical phrase "exponential growth." He pointed to a worrisome riddle that was propounded by Dr. Peter E. Glaser at a scientific conference in London. It is as follows:

"A farmer has a pond with a water lily in it. The Lily is doubling in size every day. In 30 days it will cover the entire pond, killing all the creatures living in it. The farmer doesn't want this to happen, but he is busy with other chores and decides to postpone cutting back the plant until it covers half the pond. The riddle is: on what day will the Lily cover half the pond? And the answer is: on the 29th day - leaving the farmer with just one day to save his pond!" Park (1975 page 260)

As suggested earlier, technological change within our world is growing at an exponential rate. Complex Techno-physical, Socio-cultural, and Environmental issues within our society are moving forward at what some consider to be an alarming rate. While we are not at the "29th day" some argue we may be nearing it. If as Kellner (2001) suggests we are in the midst of one of the most dramatic technological revolutions, we must ensure future generations of design students are properly equipped, in terms of using technology, to properly initiate technological changes in society. Drawing upon Christiaans and Dorst (1992) who found novice designers [design students] who did not gather information and consider the "larger" picture tended to "solve simple problems". When dealing with complex issues surrounding technological change, often industrial design and design engineering students have difficulty in identifying and making evident the relationships between larger issues that they may view as being outside the scope of their responsibilities. Design thinking in design education needs to change. It is argued here our design students need a set of tools / methods / thinking strategies that enable them to practice coping with complex interrelated EPISTLE issues. This paper proposed using the strategy of Non-hierarchical mind mapping techniques and a "Frame Game" in order to map the complex dynamic interrelationships relating to both the Design process and the broader EPISTLE issues of technological change. Thus arguing present and future designers may practice to become "Active Players" in determining the "Big" picture issues facing us. In essence from the little things, BIG things grow. Design educators have the opportunity to challenge the students in order to move them beyond the mere Problem Solving/Solution paradigm. It is argued that as a matter of urgency we need to challenge our future designers and indeed our present professional designers to be less problem – solution focused and challenge them to articulate and make evident a consideration the more complex nuanced EPISTLE issues in ALL their design decisions. Indeed, we need to act before the "29th" day arrives.

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