

# GETTING TO SUSTAIN (-ABLE SYSTEMS) VIA USING SURVIVABLE AND IMPOSE-ABLE ONES

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## **ABSTRACT**

**PURPOSE:** Engineers report projects decaying or harsh realities intruding so project outcomes lose value [1], made worse by designers trapped in their local masteries till hurt by larger scale forces [2], [3], [4]. **TOPIC:** Design must handle several intrusion/imposition types: imposed by managers ruling designers; imposed by crises changing priorities, imposed by turf wars among professions, imposed by elapsed time inviting changes, imposed by victim culture in engineers. **METHOD:** MIT alumni on LinkedIn were asked about these, their answers categorized, with descriptive stats. Seven major categories were found. **RESULTS:** Design must change in 6 ways: design systems and power configurations that use them, design sustainable systems that fallback into survivable system traits that fallback into impossible systems; create designers masters of 5 meta-sciences (design, systems, culture, innovation, quality) plus liberal arts of business for managers and social sciences of design for engineers; design cloaks hiding deeds/aims from big organization dysfunctions; apply engineering to design of policy chain processes; **IN SUM:** get designers designing the social power systems around their systems.

*Keywords: design of social power, impossible systems, survivable systems, sustainable systems, managing and engineering common ground, power design, design “getting real”.*

## 1 INTRODUCTION—THE ENGINEER-VICTIM CYCLE

Certain realities, already mentioned by others, in design and engineering, including certain lackings in engineers, design, systems engineering, and popular design paradigms like sustainable systems, got mentioned by the MIT alumni respondents of this study as a cycle of engineer dis-empowerment:

- 1) a lot of current alternative energy, building, and product systems while highly promoted, are not workable in current form, without special subsidies or mandates for use [5]
- 2) first, they get frustrated by projects decaying, eroding, or, by sudden reality intrusion, being radically gutted so sustainability gets greatly weakened in favor of design for making systems survive in crisis or newly harsh conditions [5]
- 3) second, they end up reporting to MBA-trained managers who never studied sustainable systems at all and who embody a Fama-invented efficient-markets attitude anathema to sustainable systems [6], [7]
- 4) the result, all too often, is engineers with a victim attitude, over-ruled by societal intrusions and managers, designing and implementing less than history and the world's future needs, discouraged about their own lack of influence on the larger systems, powers, forces that determine their work [7]
- 5) all the above, however, seem recently, intensified by cataclysms and disasters, wiping out years of priorities and plans, intruding in the middle of design projects with devastating changes of budget, emphasis, and sheer umpf.

The Engineer-Victim-Cycle: sustainable system not quite viable in design gutted by intruding crises and other realities, managers un-sympathetic to sustainability over-ruling engineers, victim psychology among mid-career engineers not in control of what they do and make, this leaving sustainable systems not developed to the point of full viability, causing harsh effects of our unsustainable present systems to intrude ---this cycle intensified by policy chain failures causing more intrusion of disasters and threats.

The old failure mode---engineers warn managers, managers ignore engineers for sake of keeping to schedule, shuttle explodes, NASA project loses billions and political support for years---seems to be in the process of changing to---engineers design sustainable system, managers whittle much of the

novelty out, sudden disaster changes entire project context, engineers struggle to define something small and worthwhile out of the rubble, to actually do. This new failure mode stems directly from: 1) policy chain failure 2) weakness or lack of engineering of policy chain processes and 3) weakness of engineers at policy chain influence work---say the MIT alumni respondents. Imagine two scenarios--- 1) engineers pushing for launch but managers rejecting launch due to technology risks---2) engineers putting up a grand system, with two secret fallback designs, so that when unexpected realities intrude, they merely slip into comfortable already-prepared fallback survival system design types. When those are intruded on, they slip into a second imposed system design fallback. Imagine that! How do we achieve those two scenarios as working realities of most engineers?

## 2 KINDS OF INTRUSION BY HARSH REALITIES AS RESEARCH QUESTIONS

The sense that design as a whole, that engineering as a whole, were somehow not being “realistic” comes strongly through recent publishings by engineering and design leaders, and from anecdotes by practicing engineers about their own careers. That projects lose major values due to sudden changes of budget, or rejections of project components by customers, or due to collateral changes in available technologies, or due to large-scale societal changes that reduce or redirect project priorities---these are normal. But recently, due to our poorly-engineered policy chains, more and more large scale issues (global warming, weather extremes, commodity price increases causing government overthrows, and the like, are intruding not on one or two systems projects but on thousands of them everywhere. We need to figure out how design needs to change to handle these increasing in type, size, and frequency harsh reality intrusions into projects.

Research Question 1: **MANAGER INTRUSION Power Imbalance**-- Engineering needs to “get real” in addressing the power imbalance between engineers and MBA-trained managers—how can and must we do that? Research Question 2: **CRISIS INTRUSION Survivable, Impose-able, Sustainable Systems**---Engineering needs to “get real” in addressing global warming and sustainable systems ideals, what is ideal seldom is what gets funded---how can and must we do that? Research Question 3: **OTHER FIELD INTRUSION Within & Without Domain Balance**---Engineering needs to “get real” in balancing domain excellence with ability to operate across domains---how can and must we do that? Research Question 4: **IRRATIONAL PROJECT FRAGMENTS INTRUSION Design for Latecomer Realities**---Design, especially of large systems, gets degraded or erodes, during projects from ideals to reals, often in an ugly, de-rational, sub-optimal way—how can and must we re-vision/re-teach design to prevent later-appearing realities harming design? Research Question 5: **POOR POLICY CONTEXT INTRUSION Design Politics, Powers, & Victim Engineers**---Our policy chain processes are either un-designed entirely or based on designs centuries old and far worse than any other processes in society today. More and more crises and disasters caused by large scale policy chain failure are intruding onto thousands of systems projects, greatly reducing, harming, or mis-directing them. How do we change design so as to handle this? Research Question 6: **SOCIAL FORCE INTRUSION Engineer-designers trapped in their own skills**---The skill bribes that keep engineers local inside their present skills and field, plateaus their careers and weakens project handling of non-technical factors. How do we change design to handle this? 7. **INTRUSION BY ELAPSED TIME Long projects invite large context change intrusions**---The longer a project is the more chance for major pieces of context to change forcing huge changes or truncations onto projects. How must design change to handle this well? 8) **VICTIM CULTURE INVITED INTRUSIONS Engineers blame organizations and managers for their own failures to build and handle power**---Engineers and designers often simply do bad designs till promoted to management when they switch to good designs, finally. Not a few engineers, late in careers, lament reporting, as victims, to managers screwing up brilliant designs and technical opportunities---how can and must we re-design design and design-education to stop this? How does design need to change to handle each of the above intrusions?

## 3 THE DATA—WHAT ENGINEERS SAY THEIR EDUCATIONS LACKED

MIT graduates registered on LinkedIn, the web networking site for business, were asked what was lacking in their undergraduate engineering education at MIT [8] (more exactly I asked “Why are so

many older MIT grads dissatisfied with how results of their lifework are vitiated by non-engineers around/above them in organizations/society?") and related other questions. 371 of them wrote back detailed answers, occupying 55 A3 size pages, 74 of them writing repeated answers and elaborations, 20 who offered comments starting new threads in the discussion were given skype or email later interviews. Respondents ranged from 21 to 78 years old, 55% had advanced degrees (21% multiple grad degrees); between 8 and 11% of respondents worked in each of software, EE, ME, aerospace, biology, or ChemE; 39% started or managed ventures, 18% had additional non-tech degrees.

This question was a 2009 top-in-respondents-number one for LinkedIn. I categorized their answers, and **seven** clumps of inter-related responses appeared, concerning sustainable systems, a victim stance trained into engineers during their education, and the frustration of finding all their lives themselves reporting to technology ignorant MBA types (that is, the research questions of this paper). Many engineers writing in, dealt with these topics together as inter-related. I took 140 statements (encompassing over 7000 lines of text) out of over 790 written, dealing with the inter-relations within and among these seven clumps, and analyzed them separately. The 140 statements were categorized in four ways: a) by issue salience b) by new types of engineering or design suggested c) by types of frustration and its cause d) by suggested origins of lackings and lacking in how they were educated: for each research question---power imbalance, sustainable-survivable-impose-able systems, within-without domain balance, design for intruding latecomer-realities, design of politics/powers (non-victim engineers). Categories, at all levels, were grouped by affinity then by causal chains among affinity groupings. This allowed "hypotheses" latent in items sharing categories to emerge.

#### 4 THE SEVEN MAJOR CATEGORIES IN THE MIT DATA

There were SEVEN big categories in terms of numbers of alumni mentioning points in them and numbers of mentions by each alumni, the subcategories of which had natural and obvious causal paths:

- *The Engineer Victim Cycle---already presented above.*
- *The Five Impositions/Reality-Intrusions---by manager, by crisis, by turf war, by elapsed time, by victim culture.*
- *The Design for Intruding Realities Procedure---sustainable ideals with prepared fallback to survivable system design traits, with fallback from that to imposed system design traits (use imposed systems traits to enact survival traits, use the latter to enact sustainable means/ends)*
- *Manager-Engineer Common Ground from Meta-Sciences---the five Meta-Sciences: design science, systems thinking, culture science, innovation culture, quality systems, that apply to all subfields of managing and engineering and design*
- *The Manager-Engineer Bridge Fields---the liberal arts of managing and the social sciences of design work*
- *Design of Social Power Systems---micro-design of systems/entities and macro-design of encompassing influences, forces, powers, interests configurations to support micro design contents.*
- *Proper Applying of Design and Engineering Best Practices to Policy Chain Processes---broken policy chains make all engineering projects lose morale due to larger scale social processes made badly or corruptly, policy processes that are only political dysfunction, policy processes need to be designed with best engineering levels of excellence.*
- *Recommended Changes in DESIGN:*
  - 1) design systems and configurations of powers around systems that determine their worth and use
  - 2) design sustainable systems that fallback to prepared survivable system designs that fallback to imposed system designs, with maximal preservation of sustainable means/ends at all three levels
  - 3) create designers, engineers, and managers all of whom are masters of some domain area, and masters of five meta-sciences (design, systems thinking, culture, innovation, quality) and the liberal arts of business and the social sciences of design
  - 4) design cloaking mechanisms that hide project deeds and aims from harmful big organization practices and dynamics
  - 5) apply best practice design and engineering contents to policy chain processes to lift morale

of all systems and design projects demoralized by harm from out of control or inadequate larger scale policies or absence of policies needed.

6) MOST IMPORTANT---getting designers and engineers adept at the design of systems for social power, really changing their attitude toward power, fostering an attitude in them of getting involved in development of the power of engineers, designers, engineering as a profession, and engaging engineering as a whole in the design of policy chain processes.

## 5 EIGHT UNSURPRISING ENGINEER LACKINGS FROM THE DATA

Most of the 700+ statements in the dataset covered issues well published elsewhere and therefore not very surprising. I summarize them in the table below so we can move onto the 140 statements that had novel ideas not already well reported or published.

<b>6 Lackings in Engineers and Design from MIT Alumni</b> <b>Each statement below is a category representing 10 or more lines or statements in the dataset</b> <b>(References [10-18] capture most of the below points)</b>						
LOW RANKING	SOFT NEED	SKILLS	POWERLESS	MBA ENEMY	MIS-EDUCATION	CULTURE COLLAPSE
<ul style="list-style-type: none"> <li>• lack of appreciation of engineers</li> <li>• just technical people attitude</li> </ul>	<ul style="list-style-type: none"> <li>• engineers in love with own brilliance seeing no others' points of view</li> </ul>	<ul style="list-style-type: none"> <li>• a career going to Mars cut off forever by government budget problems</li> </ul>	<ul style="list-style-type: none"> <li>• MBAs lack just as many soft skills as engineers do</li> <li>• BUT MBAs are aimed at, groomed for power and engineers tend to shun it, hurting them and design in toto.</li> </ul>	<ul style="list-style-type: none"> <li>• few MIT engineers end up in big companies</li> <li>• MIT trains you only for first 3 years of work</li> <li>• colleges teach out of date programming only not Python PHP</li> </ul>	<ul style="list-style-type: none"> <li>• USA can't do finance, healthcare, autos, climate change prep, energy independence = loss of overall design morale, with the big undone or poorly done, why do the small well?</li> </ul>	
<ul style="list-style-type: none"> <li>• as engineer I work the details somebody else runs the big picture</li> <li>• design tree bark not forests</li> </ul>	<ul style="list-style-type: none"> <li>• need for soft skills</li> <li>• communication s, trust, relationships, influence, power, authority, image = how to handle them</li> </ul>	<ul style="list-style-type: none"> <li>• weakness of entire engineering profession, lack of defending its standing</li> </ul>	<ul style="list-style-type: none"> <li>• best step to improve design outcomes = eliminate MBAs</li> </ul>	<ul style="list-style-type: none"> <li>• niceness of idea handling on campus sets up designers for later career failures (patent holding requires funds to fight off invalid claims)</li> </ul>	<ul style="list-style-type: none"> <li>• used to be long term design places—Bell Labs, NASA, IBM Watson, not anymore</li> </ul>	
<ul style="list-style-type: none"> <li>• managers proposed technically impossible orbits for 5 times engineer pay, and engineers got blamed though they were right all along</li> </ul>	<ul style="list-style-type: none"> <li>• writing, inter-personal dynamics, team building, selling, public speaking, marketing, negotiation, conflict resolution, managing up, entrepreneurship, IP law, global markets</li> </ul>	<ul style="list-style-type: none"> <li>• loss of culture of doing a good job in USA &amp; China compared to Germany, Japan, UK</li> </ul>	<ul style="list-style-type: none"> <li>• missing measures in design gives room for really bad MBA judgment and values</li> </ul>	<ul style="list-style-type: none"> <li>• nothing in any course was useful, only asides by profs running side businesses</li> <li>• real world engineering much more fun than MIT coursework</li> <li>• trained to be blind to others' views</li> </ul>	<ul style="list-style-type: none"> <li>• amazing lack of influence of engineers on policy processes</li> <li>• poor design of policy processes</li> <li>• inept voting regimes and unimproved political institutions and processes, suicide if in businesses</li> </ul>	
<ul style="list-style-type: none"> <li>• finance guys lead engineers in USA but engineers lead in Japan making other kinds of mistake (too many buttons)</li> </ul>	<ul style="list-style-type: none"> <li>• Copernicus was not excommunicated due to lack of communication skill = new ideas are hated at first</li> </ul>	<ul style="list-style-type: none"> <li>• forced by managers to design immediate trivial stuff and put off long term great stuff</li> </ul>	<ul style="list-style-type: none"> <li>• engineers who refuse management due to ugliness of the people who manage "bad smells"</li> </ul>	<ul style="list-style-type: none"> <li>• liberal arts 2 years then MIT 4 is best combination</li> <li>• joint MBA-design degree but BOTH lack soft skills</li> </ul>	<ul style="list-style-type: none"> <li>• national rhetoric treats too many issues as value dilemmas not design problems</li> </ul>	
<ul style="list-style-type: none"> <li>• Americans respect money more than design, competence, or knowledge = engineers marginal</li> </ul>	<ul style="list-style-type: none"> <li>• do evil designs till made manager then do valid designs</li> </ul>	<ul style="list-style-type: none"> <li>• when brilliance is not brilliant = engineers locally optimal but overwhelmed by large scale factors and forces that are more social than</li> </ul>	<ul style="list-style-type: none"> <li>• reports to dumb MBAs who only check for effects on their own personal wealth</li> </ul>	<ul style="list-style-type: none"> <li>• technology without law and finance is idealist illusion, worthless</li> <li>• MIT are smart people who succeed not due to anything they</li> </ul>	<ul style="list-style-type: none"> <li>• laws and legislators lack design discipline, skill, and measures</li> </ul>	

		technical		get at MIT	
• zero carbon as cocktail party engineering, few are serious about it	• technology moves so fast if you take 2 years out for soft skills you are no longer technically competent	• not a clue about how to get things done in organizations	• engineers blamed, MBAs promoted	• MITers work in academia, as managers, as entrepreneurs, not as designers in private firms	• inverse U function of innovation---too much quality and small leaps, too little quality and new ideas fail to serve anyone

The columns make the following individual arguments and combined overall one:

- the low status of design and engineering compared to wealth and finance vitiates and erodes a lot of individual engineer and designer dreams, plans, and projects
- the soft skills lacking in both engineers and MBAs means they fight rather than cooperate more than is useful or necessary
- the powerlessness of individual designers and the design and engineering professions are among the largest most important forces weakening individual design projects
- MBAs are an enemy group and culture to the extent they keep themselves ignorant of design, engineering and play the power and status trump cards during disagreements with them
- designers and engineers are mis-educated on problems in college far less interesting, broad, and challenging that real world design issues—they succeed in spite of their educations
- when overall civilizations and national cultures collapse, with policy processes either un-designed or designed centuries earlier and largely unimproved, the largest scale investments and projects undo myriad mediate and small scale excellences of designs and engineers, demoralizing these professions in *toto*.

## 6 THE MAIN SCENARIO THAT EMERGED FROM THE DATA

The main show, in the 140 statements that were judged beyond the already published, was sustainable systems projects decaying into survivable systems projects decaying into imposed systems enacted. The sustainable systems part of this is already well known. Survivable system design is engineering devices, facilities, and systems for surviving nearby threats and fully realized present crises. You design to not be destroyed by X, Y, and Z. The tertiary show was imposed systems: parts of survivable ones suddenly funded and launched in reality. This is a set of parts of survivable systems suddenly agreed on and done by parties that usually in society are at each others' throats. This is not worked for agreement but the sudden unbidden appearance of agreement that surprises one and all. Sometimes it is a survivable system being agreed on because the threat that causes it is so immediate and great, but often, it is mere parts of a survivable system suddenly being supported, irrationally. Imposable systems are systems people become willing to impose on themselves, changing their usual stance of no one willing to give in till after other parties give in, during disagreements. People tend to impose suddenly parts of survivable systems they discuss, and never get to sustainable systems that are more ideal. The policy chain---spotting a growing threat and making policy responses to head it off---is broken for many of our biggest threats, global warming already costs billions in tsunamis, extreme weather events, and infrastructure imposed commodity cost increases overthrowing governments. We are installing counter-measures too late, too small, so we can expect increasing intruding of unwanted harsh realities in mid-project, turning sustainable projects into survivable ones, and turning survivable ones, into imposed ones.

The overall scenario that emerged from analysis was as follows:

- 1) excellent engineering projects are set up and underway, when harsh realities intrude, imposing drastic changes on them
- 2) various threats to survival of society or its key parts appear (everything from terrorism, and global warming, to higher energy costs) or are actualized, devastating budgets, media, priorities
- 3) so projects that start out long term and highly beneficial in systems senses erode into or collapse into or are forced into survival systems getting designed, to handle exigencies suddenly on stage
- 4) but these survival systems projects decay, as well, not getting funded fully and instead convenient, highly irrational pieces of them are agreed on by threatened or devastated parties

- 5) so designers, demoralized, recover as much of value as they can from the ruins of their initial sustainable technology project, then from their mediate survivable system project, and execute a modest immediate imposed system, that relevant parties could temporarily agree on
- 6) enough experience like this and designers learn to use imposed system features to execute survivable system features, which they in turn use to execute longer term beneficial sustainable system features.

<b>DESIGN FOR LATE-COMER INTRUDING REALITIES: Process of Decay of Sustainable Ideals into Survivable Projects Parts of Which Get Enacted as Imposed Projects.</b>			
NAME	SUSTAINABLE SYSTEMS	SURVIVABLE SYSTEMS	IMPOSE-ABLE SYSTEMS
DEFINITION	our long range vision	what projects get discussed, chosen	what projects get funded and done
DESCRIP-TION	an entire new basis and technology set and way to live for human civilization	huge vast emergencies and crises that suck all the attention and funds from sustainable system projects and intents	under the urgency of crisis, some usual stakeholder differences of interest, subside enough for something immediate to be agreed on and funded, usually rather suboptimal subsets of survivable systems
EXAMPLE:	Japan March 2011 Earthquake Example: Entire towns and tens of thousands of people gone. Clean slate for sustainables.	Japan March 2011 Earthquake Example: The pressure and attention are NOT for sustainables but for survivables 1) can anything be restarted here? 2) what design would survive such huge tsunami's in the future?	Japan March 2011 Earthquake Example: The actual first decision being made in April, one month after, is 1) do not rebuild—depopulation and aging population forces make that futile 2) re-think re-design much of Japan's coastline defenses and coastline nuclear facilities 3) how much survivable design capability can we now <b>afford/impose</b> ?
DESIGN THEMES AND CONTENTS:	An entire new way to work, live, and new technology paradigm for all. Bio-Sense Replacing Mechano-Sense--- bio-inspired bio-preserving systems (minimal footprint humanity), biodiversity as design library: Ecosystems of technologies, businesses, markets Ecologic: commonsense, innovations, borders Ecologic: media, educations, careers	Jobs = political design pressures; Energy = cost design pressures; Pollutions = health design pressures; Financial theft crises = democracy design pressures; Weather extremes = infrastructure design pressures; Web-ization = industry bypass design pressures; Rampant privatizations = re-public-ization design pressures; Culture/Religious wars = re-nation-ization design pressures; Nuclear-Bio terror = global defense design pressures; Resource shortages = innovation (bio) design pressures;	Sustainable values and ways, cloaked in survivable features, cloaked in do-able imperatives:  We all can agree, right now, on: Design for: Manufacture by: Sell as: Use in: Dispose to: Reuse for:  Design of design of system to mitigate impose-able sub-optimals and survivable sub-optimals preserving sustainable optimals, cloaked.
DESIGN APPROACH INNOVATIONS	Design of policy chain processes; Designs with facilities for influencing stakeholders outside the design system function perimeter.	Black swan designs; Concentric protective design (cores disaster safe); Gracefully degrading systems; Technologies of invulnerability	Design of likely subsets of sustainable system. Modularization of peripheral (to outside forces) design functions, for graceful design shrinkage when arbitrary agreements among parties happen.
REQUISITE	Scope, various chains: supply, produce, customer, waste-reuse, policy chains		

CHANGES IN DESIGN	Non-victim engineers as powerful as MBA managers, designers of power
	Engineers add social sciences of design and Managers add liberal arts of business, moving toward, thereby, each other and common ground
	Engineers & Managers both lacking soft skills and social/emotive skills = Educate both in meta-sciences: design, quality, innovation, culture, systems that cut across all professions and design sub-fields
	Dual design scales---micro-design of project components and macro-design of ways to influence the powers around projects that use or mis-use their outcomes
	Design of social power systems---something all designers and engineers should learn
	Apply design best practices to design of policy chain processes

## 7 ENGINEERING FOR SURVIVABILITY, DESIGN FOR IMPOSITION

The above scenario: threats or disasters forcing abandonment of sustainability goals for survivable designs and decay of those projects into expedient do-able-at-the-moment imposed systems projects, with designers gradually using imposed system traits to enact survivable system traits, then using both sets of traits to achieve sustainability long-term goals and values, suggests Survivable systems and Imposable systems are not designed as Sustainable ones are.

So the question arises---what does “engineering something for survival” entail? Most elementally that gets answered by “what threatens our society's survival?” *This is a “black swan event” type of robustness---design to survive what we do not plan for and expect.* In the MIT alumni data, the following items appeared, as increasing in size and frequency harsh intruding realities that drastically change engineering and design projects:

1. jobs lackings produce political pressure--design systems to increase employment
2. energy prices produce cost pressure--design systems to use less energy (or to capture waste as energy)
3. pollutions produce health pressure--design systems to reduce national health system use and cost
4. financial theft crises produce democracy pressure--design systems to reduce income inequalities
5. harsh unusual weather produces infrastructure pressure--design systems to protect from weather extremes beyond historic norms
6. web-ization produces industry bypass pressure (whole other industries put out to pasture)--design systems to operate entirely on a web basis while maintaining a pre-web capability
7. rampant privatizations produce re-public-ization pressure--design systems to work efficiently with public management and work honestly with care with private management
8. culture and religious wars produce re-nation-alize pressure--design systems to institutionally split by long standing ethnic /tribal divides without loss of function
9. nuclear/bio terror produces global defense pressure--design systems to isolate from kinds and aspects of their environments, keeping inside from going out and outside from going in
10. vertical resource searches (the globe's places already covered, we have to go up or down for more resource) produce innovation pressure--design systems to substitute present resources forms for near match entirely different ones.

Then the question arises---what does “engineering something for being an imposed system entail?” In the data the following items appeared:

### **A. Use Imposed System traits to enact Survivable System traits to enact Sustainabilities**

1. design for---survival and sustainability using imposed system traits/specs
2. manufacture by---survival and sustainability using imposed system traits/specs

3. sell as---survival and sustainability using imposed system traits/specs
4. use in---survival and sustainability using imposed system traits/specs
5. dispose to---survival and sustainability using imposed system traits/specs
6. reuse for---survival and sustainability using imposed system traits/specs

**B. Design for Survivability statement in the data**

1. black swan designs---isolate core from lose-able functions, graceful transition switches
2. differential protection design---side-step, wrapping, diversion counter-measures for modules divided into exposure to disaster risk and criticality of function loss risk
3. technologies of invulnerability---all design parameters optimized for disaster avoidance and handling
4. design for essential functions---radically pruned down function sets in the system as backups or alternates, or protected cores of large nicer systems
5. design disaster destruction paths---fortify actual step by step paths disaster results spread by

**C. Design for Imposition statements in the data**

1. design client-function-based modules---so types of functions can cleanly leave the design suddenly if needed leaving the rest functionally complete d
2. graceful scale shrink design---so the size, speeds, quantities of the overall design scale can be cut severely leaving smaller, slower, etc. versions that work of all modules g
3. excuse & cover system design---design so parts of a system appear valuable, relevant, and effective to outside constituencies and stakeholders e
4. design serial project system---design so that a project's functions can be strung out, delivered one by one over a number of years/decades, when later funding arrives d
5. safe-effective-endurable-fixable system violating designs—designs that are parts of systems with faster-cheaper-easier facsimiles of systems relations and effects s
6. hakkei designs---designs that borrow functions and supports from existing other systems (*shakkei* is a term from Japanese gardening, using scenes outside the garden) s
7. half/quarter/eighth budget/schedule designs---designs with 3 size versions of each component h
8. competing track designs---full systems version and cut-rate version developed in parallel teams competing to complete all requirements with radically different amounts of resources c
9. sequenced/rotated/shuffled function designs---slower cheaper designs for delivering needed functions that build up to needed amounts via sequencing, rotating functions, or inter-leaving functioning s
10. access-delivery-cascades evolving system designs---designs of systems that pour, spread, flood, speckle or otherwise gradually cover needed areas of function delivery rather than covering all places needed all the time. a

**8 REALITY TWO---ENGINEERS REPORTING TO M.B.A. MANAGERS NOT ENAMORED WITH SUSTAINABLE SYSTEMS**

The MIT engineer respondents complained mightily that training in college did not prepare them for having their best technical ideas and solutions undermined by managers. Indeed, quite a few stated that their engineering education prepared them *to* become victims of managers. “If I had known I would spend my entire life, justifying the obvious to managers who controlled my pay and career, oblivious to technical concerns and excellence, I would have ....” quite a few respondents said. This



blends easily with Ruffa of NASA's article[4] on learnings in systems engineering, where he declares in several distinct places and ways that what appeared technical became social, that focus on technical things caused the omission of more powerful social forces in the system of each project. Designers and engineers tended, in his experience, to be too technical to do technical tasks well and safely. Designers and engineers tend to lack “soft skills”.

But MBAs also lack soft skills[10]. When they argue with engineers, because both parties lack soft skills, things get decided by default power hierarchy---the MBA manager usually wins[13]. If we examine engineering programs for sustainable ideas and content and MBA programs for the same we find a huge imbalance---nothing on the MBA side and lots of content and courses, new degrees and even new departments on the engineering side. We are raising generations of engineers to lose fights with generations of MBAs over sustainable technologies.

9 TEACHING WHAT MANAGERS & ENGINEERS ACTUALLY DO

The table below is what they do, and I will present what the sample of MIT engineers thought about “ways to go” and “solutions” using it.

THE NEW DESIGN ALGORITHM: Use Do-able Design Traits of Imposed Systems to Embody Survivable Design Traits that Themselves Embody Sustainable Ideals, Ends, and Means		MANAGE & DESIGN FOR SURVIVAL					
		Isolation (terror)	Employ (jobs)	Health (less use)	Culture wars (re-nationalize)	Energy cost rise (reduce use/price)	Etc.
<b>MANAGE &amp; DESIGN FOR SUSTAIN-ABILITY</b>	Waste recycle & industrial ecosystems						
	Gross national happiness						
	Carbon neutrality		<b>MANAGE &amp; DESIGN FOR IMPOSITION: Spotting and Going After the Do-able, &amp; Using it for Survivable Design Traits that Embody Sustainable Ideals, Ends, Means</b>				
	Coastal float systems & bio-inspired design						
	Water capture efficiency						
	Urban sustenance farming						
	Etc.						

My respondents suggested hundreds of solution types and actions but key categories from that included the below:

- Engineers “on the top of the world looking down on creation/managers”
- Design as common ground between engineering/technology and management
- New joint Science + Management master's degrees PSMs (already offered)
- Anti-MBA Masters of Management---entirely West coast democratization of media and venturing contents, no Wall Street stuff
- Meta-Disciplines taught/practiced in Systems Engineering add-on years---sciences of how to cross disciplines/professions: systems tools, culture tools, design tools
- Formal engineering school surveys that critique “engineer encountered” MBA manager values, views, results, and behaviors---challenge the enemy

- Managers can work in any function of any industry but mechanical engineers, for example, are vastly more limited in where they can contribute well---fix that by a meta-engineering field, the design of work systems, marketing systems, technical systems.

## 10 ADJUSTING THE ENGINEER MANAGER POWER IMBALANCE

Scale seems to be a major causal variable [9]. In Silicon Valley ventures, managers do junk work and PR while real work is done by the head of technology. At a certain size, salience switches to the manager from the technology and product head. Venture founders remark that taking venture capital ruins ventures usually because venture cap firms put board members on the venture's board who are MBAs [9]. These guys have a special "religion" that blue suits and fighting separate divisions, each headed by overpaid underworked vice presidents, are "how normal business gets done". They impose this religion on ventures, killing them [9]. Indeed, the culture of Silicon Valley founders is virtually an "anti-Wall-Street", and "anti-MBA", an "anti-East-Coast"[9]. But a lot of that can be understood as anti-bigness [9]. Engineers lose out to managers when ventures succeed and grow in size. Indeed, even the intent to grow is sufficient to kill most ventures. Rather than plans "to grow" venture founders tend to recommend "serving customers faster and better" then growth will take care of itself whereas planning and doing "growth" will mean the venture out-grows quickly its values, passions, and culture, dying quickly [9]. Lest readers dismiss this as exaggerated thinking, Mintzberg at McGill University has set up a kind of anti-MBA program---designed to undo to people what standard US MBA programs turn them into [19].

Prof. Martin, head of the University of Toronto's MBA program, has written books [20] on design thinking for managers, about researching not how businesses now do things but how they might do things newly, and about injecting the excellence drive and artfulness of furniture, architecture, and fashion design into how business systems and businesses get designed. The MIT respondents generalize this idea to extending design to policy chain processes. *Engineers design everything BUT the major power determinants of their success.* The MIT respondents go on to suggest that design can unite management and engineering in some ways. Adding basic human decency and values to MBAs is being attempted by new programs like the new hybrid humanities and MBA joint program between Brown University and IE Business School in Madrid [21]. Software management by non-programmers---the way to Microsoft style decay---was mentioned by several respondents as a field of engineering where MBAs have made little headway. Software, managed by managers not software-trained, rapidly turns to disaster, respondents noted. Since more and more mechanical, electrical, automotive, chemical, aerospace, and biologic engineering is software based or mediated, software may be a force driving the scope MBA style managers smaller [see also 22].

## 11 CONCLUSION---DESIGN CAN GET REAL IN SIX WAYS

Teaching design for survival, with a brief excursion to design for imposition, then show how design for sustainability can *use* the both of them for its longer range purposes, prepares engineers to not be victims of managers and MBA culture. Some changes in how we educated designers and engineers are strongly suggested by the above.

- 1) Teaching social sciences to designers and design of systems of power in social institutions around and in systems projects. t
- 2) Teaching management as design work and engineering as design work while
- 3) empowering engineers with four more tool-sets for operating across boundaries that nearly all MBAs lack---culture science, systems science, innovation science, quality---will redress some but not all of the power imbalance between managers and engineers.
- 4) But simply teaching that power imbalance and cases of handling it well and badly, will prepare engineers to be non-victims and foster strategies from them for managing the MBA managers that they encounter and countering the venal sub-culture that MBAs are steeped in.

In sum: Design Must Change:

- 1) design system (micro-design) and contexting configuration of powers around it that value and use it (macro-design)

- 2) design imposed now system to embody survivable system traits that themselves embody sustainable system contents
- 3) design by envisioning likely future reality intrusions then designing sustainable ideal with fallback to survivable system traits, and further fallback to imposed system traits
- 4) unite management and engineering via meta-sciences of quality, innovation, systems thinking, culture, and design-science
- 5) humanize management via liberal arts of business and socialize engineering via social sciences of design to enable simultaneous management co-design with engineers
- 6) design the cloaking of project deeds and intents to handle dysfunctions of big organization dynamics
- 7) ancient non-experimentally confirmed policy chain processes are no longer safe and functional---*we need re-engineered policy chains*—apply the best in design science and engineering to re-do policy chain processes.

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