OVERSIGHT AND STEERING FOR EFFECTIVE SYSTEM DESIGN

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ABSTRACT

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Many factors enter into successful design. A systematic study of design has revealed that from among the many types of factors involved in arriving at successful designs, the factors that relate to oversight and steering are the most plentiful. Moreover, it has been found that these factors are mostly not those associated with management, but rather they are typically philosophical and scientific in nature.

This suggests that effective system design requires management with a strong philosophical and technical orientation, stronger than that normally encountered among technical managers.

A second finding is that the requirements for oversight and steering are not normally studied either in higher education or in management programs by those who typically take responsibility for managing large-scale design projects. This suggests a serious mismatch between the kind of knowledge that is needed for effective oversight and steering and the kind of knowledge held by those who presently have such responsibility.

The kinds of knowledge needed for oversight and steering will be described, and their correlation with the elimination of numerous detractors to effective system design will be indicated.

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It is sometimes thought that the primary factors in successful design are (a) creative thought about the design target and (b) technical knowledge about the components to be used in producing the design target.

While these factors are certainly important; in the area of large-scale system design, and to a lesser extent in design in general, oversight and steering are more important than creative thought and technical knowledge. The reason is related to scarcity of resources. We are able to find many people who are creative and have technical knowledge, but it is hard to find anyone who can articulate sensible proposals for oversight and steering of the design of large-scale systems.

One of the reasons oversight and steering is vital to effective system design is that there are many detractors [1] at work to prevent such design, and these will not yield to anything other than strong oversight and steering of the design process.

It is the purpose of this paper to take the five categories of detractors identified in [1] and show how appropriate oversight and steering can overcome the detractions, and thereby clear the way for effective design to occur. Also it is our purpose to clarify what is meant by "appropriate oversight and steering".

DETRACTORS

It was shown in [1] that detractors to effective system design can be placed in five categories. The categories and the detractors in these categories are shown in Table 1.

TABLE 1

DETRACTORS TO EFFECTIVE SYSTEM DESIGN

CATEGORY	DETRACTORS IN THE CATEGORY
ORGANIZATION/ MANAGEMENT (14 detractors)	D2 Defects in the working environment D6 Institutional indifference D9 Substitutes for design D12 Knowledge disavowal D13 Groupthink D14 Spurious saliency D16 Lack of knowledge integration D19 Lack of leadership discipline D22 Bad incentive systems D23 Territorial imperatives and elitism D25 Cultural Canals D26 Hardening of the Categories D27 Preemptive Language D28 Organizations
THE INDIVIDUAL (7 detractors)	D1 The limit to the Span of Immediate Recall D7 The egotistical designer D8 Lack of discipline D15 Arrogant abuse of power D20 Lack of relevant design experience D24 Parochialism D29 Myopic individual behavior
SOCIAL (6 detractors)	D7 The egotistical designer D13 Groupthink D17 U. S. technical chauvinism D20 Lack of relevant design experience D22 Bad incentive systems D23 Territorial imperatives and elitism
PROFESSIONAL (5 detractors)	D3 The extrapolation of design processes beyond scale D4 Floating methodology D5 Imbalance among situational factors D18 Lack of design knowledge D27 Preemptive language
ACADEMIA (3 detractors)	D10 The lack of sound reference criteria D11 The lack of instruments and units D21 Lack of formal education in design

It can be seen in Table 1 that the majority of detractors lie in the area of Organization/Management. This suggests that oversight and steering, normally associated with organizations and management, would offer the most promising approach to weakening or eliminating the detractors.

But aside from those directly categorized as Organization/Management, we note that those detractors associated with the Individual can become concerns of oversight and steering, involving responsibility to take corrective measures. Likewise, the Social category can also become concerns of oversight and steering, as can the Professional category and the Academic category.

Oversight and steering is the invariant key to change in all five categories. What changes as we move from category to category is the kind of oversight and the kind of steering that is required, as well as the type of corrective measure to be provided through oversight and steering.

EMPIRICAL BACKGROUND

For quite a few years, a combination of development of design science, testing of this science with a diverse collection of groups in actionable situations, design and use of a situation room called DEMOSOPHIA as a working environment, and assessment of all of this has produced a set of convictions concerning how to minimize or eliminate the various detractions, as well as to enhance the quality of designs.

The various designs that were involved in carrying out the foregoing embodied certain hypotheses, and the testing of those hypotheses have produced the convictions. One of the convictions that came from this work is that the other convictions can be empirically validated with data. However this has not been done as yet. It is probably worth mentioning that when working with groups the lack of emphasis on data-taking may itself be a favorable factor. Such data as have been accrued over several years of group work were those that would be required to resolve the issues being studied, and to do the designs that were at stake. But some of these data also reflect process characteristics, as well as diversity of opinion in groups, and other interesting matters, including structural metrics having to do with how complex issues get organized. As time continues, some of this information will be converted to numerical form. For the time being, the "convictions" substitute for the more sharply defined research products anticipated in the future.

The major convictions that have been identified from this work which bear on detractions are as follows:

- Environment. A neutral environment, not part of any "turf" associated with the specific issue or design, offers many advantages; especially when it is especially designed to facilitate the problem-solving system or design system which it is intended to support.

- Science. A science of design, and most any other science should have three parts:

    * FOUNDATIONS, which provide the fundamental basis for decision-making concerning all other aspects of the science, including its applications

    * THEORY, which provides the language and explains the key concepts, and which is steered by the FOUNDATIONS; and which provides screening criteria for
    * METHODOLOGY, which is the basis for dealing with problems, i.e., with APPLICATIONS. The APPLICATIONS must provide corrective information for improving the science.

- Authority. The capacity to exercise authority over situations should generally be exercised sparingly; and should not be substituted for other means of adjudicating, where knowledge is more vital than authority. There are selected times when authority may be the only means to effect certain kinds of change.

- Quality. Quality of performance in design can be greatly enhanced by the appropriate mix of authority, science, and environment.

Next we shall turn to how these factors: authority, science (with Foundations, Theory, and Methodology), and environment (the DEMOSOPHIA), can be brought to bear on the detractions identified in Table 1, with good results.

IMPACTS ON DETRACTORS

We now give a necessarily limited overview of the means of dissolving the effects of the detractors and enhancing the desirable activities that would otherwise be damaged by the detractors. Tables 2 and 3 give only coarse overviews, but these can be supported in much greater depth in longer treatises.

Table 2 describes briefly how each of the detractors can be impacted by proper use of Authority, proper Science, and a well-designed Working Environment. For some of the detractors, only one or two of these three factors are involved; while for others, in the extreme, all of them functioning together may be required to overcome the detraction.

Table 3 offers another window on overcoming the detractors. While Table 2 involves the Science as a whole, Table 3 involves three Laws coming from the Science of Generic Design, each being represented by a key word from the Theory portion of the Science. These words are: Variety, Parsimony, and Saliency. Each of these represents one or more aspects of the Methodological part of the Science of Generic Design, where the detailed aspects can be seen that have impact on the detractors [2]. Thus our present discussion should be seen as a shallow overview that may stimulate careful study of the details that support the generalities offered here.

DETRACTOR	NOTES ON AUTHORITY	NOTES ON SCIENCE	NOTES ON WORKING ENVIRONMENT
1. The limit to the human span of immediate recall **5. Imbalance among situational factors**	**Not very useful re these detractors**	**Can explain these and tell how to correct them**	**Can incorporate means to enhance the design process by controlling information flow rate, and assist in getting the necessary situational balance**
2. Defects in the working environment	Can authorize funds to construct proper environment	Can explain what the environment should be like	Can eliminate the defects and enhance human performance substantially
3. Extrapolation of design processes beyond scale 8. Lack of discipline 9. Substitutes for design 18. Lack of design knowledge 21. Lack of formal education in design 28. Organizations	Can bring influence to bear to stop bad practices, and authorize appropriate ones	Can show how to correct bad practices, how to compensate for things that are lacking, and how to redesign disfunctional units	Can provide an environment that uses the results from science efficiently to create discipline, eliminate inappropriate processes, and replace them with appropriate processes, tested against the foundations of the design science. Can also provide for substantial learning during the design activity, with suitable documentation.
4. Floating methodology 19. Lack of leadership discipline 22. Bad incentive systems	Can set higher standards that incorporate scientific knowledge, and that reflect new incentives	Can explain why and how to correct these detractions, and show how to replace them with enhancements	Generally not needed, but might be useful to design new incentive systems
6. Institutional indifference	Use influence to change priorities		
7. Egotistical designer	Require behavioral flexibility		Accomodates this role as a member of a facilitated team
10. Lack of sound reference criteria 11. Lack of instruments and units		Can furnish such criteria, and can develop appropriate instruments and units	
12. Knowledge disavowal 13. Groupthink 14. Spurious saliency 16. Lack of knowledge integration		Can clarify these detractions and provide methodology and facilitation system to correct them and to enhance appropriate replacements	Presents an environment and processes that make such detractors inoperable, while replacing them with constructive activity and means, as needed
15. Arrogant abuse of power 17. U. S. technical chauvinism	Can enhance sensitivity to these matters and bring influence to bear against them and in support of alternatives	Can provide means that make such attitudes obsolete	Presents an environment that allows for effective movement and results that are based in science rather than personality or culture
20. Lack of relevant design experience 23. Territorial imperatives and elitism		Can clarify what is needed to allow the experience to be gained and to be valuable, and can show clearly how to replace territories with collaborative effort	Presents an environment designed and equipped to eliminate these detractors
24. Parochialism 25. Cultural canals 26. Hardening of the Categories 27. Preemptive language		Corrects and replaces these detractors by providing satisfying alternatives	Corrects and replaces these detractors by providing neutral turf and facilitation and methodologies that eliminate the possibilities of sustaining such detractions
29. Myopic individual behavior		Explains what is needed to self-correct	

TABLE 2. CORRECTIVE AND REPLACEMENT-WITH-ENHANCEMENT IMPACTS OF AUTHORITY, SCIENCE, AND THE DESIGNED ENVIRONMENT UPON THE DETRACTORS TO EFFECTIVE DESIGN

DETRACTORS TO EFFECTIVE SYSTEM DESIGN

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	VARIETY	PARSIMONY	SALIENCY	DEMOSOPHIA	
GENERAL					
• UNDERCONCEPTUALIZATION	●		●		
• UNDEREXPLORATION OF MEANS					*(1)
• LACK OF DISCIPLINE	●	●	●	●	
• IMBALANCE AMONG BEHAVIORAL/TECHNICAL/ SCIENTIFIC FACTORS	●			●	
STEERING-RELATED					
• REFERENCE CRITERIA FOR DECISION-MAKING			●		
• DISCIPLINE THROUGH LEADERSHIP METRICS				●	
• SPURIOUS SALIENCY	●		●		
ORGANIZATION-RELATED					
• INSTITUTIONAL INDIFFERENCE					*(1)
• BAD INCENTIVE SYSTEMS					*(1)
• KNOWLEDGE DISAVOWAL	●			●	
• GROUPTHINK	●		●	●	
MIND-RELATED					
• COMPLEXITY		●		●	
• LIMITS TO SPAN OF KNOWLEDGE RETRIEVAL		●		●	
MEANS-RELATED					
• BAD LANGUAGES				●	
• LACK OF INSTRUMENTS AND UNITS					*(2)
• FLOATING METHODOLOGY				●	
• DEFECTIVE WORKING ENVIRONMENTS				●	
• LACK OF DESIGN KNOWLEDGE	●		●	●	
• LACK OF KNOWLEDGE INTEGRATION				●	
EGO-RELATED					
• SUBSTITUTES FOR DESIGN ACTIVITY					*(1)
• FLOATING METHODOLOGY				●	
• ARROGANT ABUSE OF POWER					*(1)
• EGOTISTICAL DESIGNER				●	
• U. S. TECHNICAL CHAUVINISM					*(3)
EMBEDDED IN OUR "SYSTEMS"					
• INTRINSIC IDEAS	●		●		
• HARDENING OF THE CATEGORIES				●	
• PREEMPTIVE LANGUAGE				●	
• SNOW'S TWO-BLOCK PARTITION	●	●	●	●	
• MYOPIC BEHAVIOR/SCIENCE/DESIGNER	●		●	●	
• PAROCHIALISM	●		●	●	
• EXTRAPOLATION OF PRACTICES BEYOND SCALE THRESHOLDS				●	
• TERRITORY/ELITISM				●	
• ASSOCIATIONS	●		●	●	
• CULTURAL CANALS	●		●	●	
• "NORMAL" ACCIDENTS				●	
• "NORMAL" MEETINGS				●	

*(1) REQUIRES CHANGE OF MANAGERIAL VIEWS
*(2) REQUIRES RESEARCH
*(3) REQUIRES CULTURAL CHANGE

THIS TABLE LISTS A NUMBER OF CATEGORIES AND INSTANCES OF DETRACTORS TO EFFECTIVE SYSTEM DESIGN. THE GENERIC DESIGN SCIENCE, INCORPORATING LAWS RELATED TO VARIETY, PARSIMONY, AND SALIENCY; AND THE PRACTICE OF GENERIC DESIGN AS CARRIED OUT IN THE SITUATION ROOM DEMOSOPHIA, PROVIDES MEANS OF OVERCOMING MANY OF THESE DETRACTIONS. ENTRIES IN THE TABLE INDICATE THAT THE CONCEPTS REPRESENTED BELOW WILL BE EFFECTIVE IN ELIMINATING THE PARTICULAR DETRACTION REFERENCED.

CERTAIN DETRACTIONS MUST BE OVERCOME BY OTHER MEANS BEFORE THE CONCEPTS LISTED BELOW CAN BE FULLY EFFECTIVE.

TABLE 3. CONTRIBUTIONS OF FACTORS TO ELIMINATION OF DETRACTORS TO EFFECTIVE SYSTEM DESIGN

MANAGEMENT IMPLICATIONS

So far we have suggested that (a) there are many detractors to effective system design and (b) the means exist to overcome these. Our general thrust is, however, that oversight and steering are required, to put these means to work to attain their potential. What are the implications of this statement insofar as management of design activity is concerned?

As indicated in [1], organizations and management are the source of many of the detractions. This suggests that management of design activities, as currently functioning, is a significant part of the problem. This means that management of design activity is not presently informed concerning how to do that job. If it were informed, it would know the relevant Science of Generic Design, it would provide the proper Working Environment, and it would cut back on the extent to which Authority is used, and apply it only to the extent suggested in Table 1.

What kind of person and what kind of learning is required to manage design activity?

First of all, in the absence of an understanding of the Science of Generic Design, the manager will not understand what is to be done and why it is to be done. Therefore the manager must be, in some sense, a scholar of science. But more than this, one notes that the Science of Generic Design has many of its roots in the following areas: philosophy of science, psychology, linguistics, and logic. These are not areas that engineering designers typically study; and when they do study logic, for example, they do it much more from a strictly functional point of view as perceived in some specific design area than as a liberating branch of knowledge with a 2500-year history, and the capacity to touch all forms of human reasoning.

The study of psychology is also severely limited, and certainly is not oriented toward how a science can be devised that enhances human capacity. What current efforts are being done are by and large directed to the most simple things such as painting pictures of smoking cigarettes on automobile cigarette lighters and installing irritable horns in locomotives to wake the unfortunate train engineer who might not notice a danger signal at the side of the track.

Linguistics is virtually ignored, and philosophy is not much better off.

There is even an ethical component to all of this, and it is very gratifying that the Massachusetts Institute of Technology is beginning to restore the teaching of ethics in its undergraduate programs.

In summary, most current managers, schooled in such subjects as decision science, marketing, accounting, and linear programming, are not likely to be effective as managers of design, even though at present the major decisions involving large system designs are in the hands of people with this kind of background or, alternatively, with a very specialized background in a particular area where Specific Design Science, entirely mechanistic in nature, holds sway.

There are people, however, who are schooled in the subject matter that underlies Generic Design Science. Some of them have the understanding required. The implication is that if people such as these can grasp the reins of power, the face of design might change radically. But many of them will not have the technical expertise, so they will have to team up with a strong technical individual who has the capacity to work cooperatively with the kind of manager we have identified.

IMPLICATIONS FOR EDUCATION

What can you say about a $300 billion dollar industry that focuses almost exclusively upon analysis as opposed to design and synthesis, while all around it systems are being created that threaten life and limb, by people who have never studied design, and who are responsible for many of the detractors we have listed?

We can only hope that the educational system somehow will become more insightful into prospects for the future of life on the planet, and more willing to intervene in what are now seen as "professional" arenas.

While it may seem quaint to some to imagine that people who study philosophy of science, psychology, linguistics, generic design science, logic, and similar areas would come to be powerful managers, the alternative currently in place is even more quaint.

Thus the implications for education seem to be as follows:

- The study of integrated science, such as systems science that integrates philosophy and related fields would seem to be beneficial
- Starting a few degree programs that are focused upon education for design, in the liberal sense of the term, might prove to be valuable
- Professional schools, such as engineering schools and business schools, might start to reflect upon the implications of many decades of neglect of design, and might even be willing to consider (however briefly) that Auguste Comte was not playing with a full deck

REFERENCES

1. John N. Warfield, "Detractors to Effective System Design",
2. John N. Warfield, "Education in Generic Design", Proc. of the Society for General Systems Research, Salinas: Intersystems, 1986, H46-H59.