

THE MODERN CONCEPT FOR
ANALYSIS AND SYNTHESIS
BASED ON THE THEORY OF RELATIONS

1. ANALYSIS. WE CAN USE THE (NOW) SOPHISTICATED VERSION OF PLATO'S DEFINITION BY DIVISION OR SEARCH FOR ESSENCES.

THIS CONSISTS OF THE FORMAL MATHEMATICAL CONCEPT KNOWN AS "PARTITIONING", OR ITS COHORT, "COVERING", OR ITS MORE GENERAL COHORT, "BREAKOUT".

WE CAN SYSTEMATICALLY REPRESENT THE SET OF POSSIBLE DIVISIONS AND WE CAN COUNT THE POSSIBILITIES. WE CAN PORTRAY THE RESULTS IN A HIERARCHICAL STRUCTURE, JUST AS THAT ILLUSTRATED IN PLATO'S DEFINITION OF "ANGLER", EXCEPT THAT WE NOW CAN COMMIT THE POWER OF THE COMPUTER TO THE MANIPULATIONS OF PARTITIONS, COVERS, ETC., USING THE MATHEMATICS OF RELATIONS, IN SOME CASES PARTICULARIZED TO ALGEBRAS OF PARTITIONS, ETC.

2. SYNTHESIS. JUST AS THE HIERARCHY OF PARTITIONS (OR COVERS OR BREAKOUTS) EXPANDING FROM TOP TO BOTTOM IS THE FOUNDATION OF ANALYSIS, THE REVERSE IS THE FOUNDATION OF SYNTHESIS. WE MAY BEGIN WITH INDIVIDUAL SETS, AND GRADUALLY COALESCE THESE INTO HIGHER-ORDER ENTITIES, USING THE CONCEPT OF THE LATTICE OF SUBSETS. THIS ACCOMPANIES THE CONCEPT OF POWER SET, WHICH ENABLES US TO CORRELATE OUR WORK WITH THE PSYCHOLOGY OF BOUNDED RATIONALITY. WE CAN ALSO COUNT ALL THE SUBSETS, THE SIZE AND OTHER CHARACTERISTICS OF LATTICES, ETC., AND WE CAN PORTRAY SIDE BY SIDE THE PRODUCTS OF ANALYSIS AND SYNTHESIS, USING THESE DIALECTICALLY TO SUPPORT DIALOG AND DESIGN. THE AVAILABILITY OF THE COMPUTER AND THE THEORY OF RELATIONS ALLOWS US TO TRANSFER THE OFFENSIVELY DETAILED PART OF THE WORK TO THE MACHINE, IF WE ARE WILLING TO UNDERGO THE THOUGHT NECESSARY TO MAKE THAT TRANSFER POSSIBLE.

From the following sets of propositions, one member of each set must be true.

Set A.

1. There exists a well-developed, functional body of knowledge called computer science.
2. There exists a body of knowledge called computer science which is underdeveloped.

Set B.

1. The foundations of a science stem directly from the ~~xxxxxx~~ social ~~xxxxxxx~~ need for understanding and competence in dealing with applications of the science.
2. The foundations of a science are inherent in the interests of its adherents, and have little to do with the need for understanding and competence in dealing with applications.

Set C.

1. Science being organized by disciplines, it can be expected that a discipline can be isolated from the rest of science in its language and in its substance, and still serve applications very well.
2. Science being organized into disciplines, but applications arising without regard to disciplines, it can be expected that to be effective a discipline must identify those proximity disciplines that relate to it, and maintain a continuously synergistic and communicative relationship with those disciplines; thereby modifying its own nature through osmosis of knowledge.

Set D.

1. In businesses that involve science, there is no need to maintain vigorous surveillance over foundations and theory, because it is only methodology that is applied, and methodology can be developed directly from applications needs, without corresponding foundations and theory.

2. In businesses that involve science, there is a very strong need to maintain vigorous surveillance over foundations and theory, because methodology that does not recognize foundations and theory is almost certainly defective, and competitors (either in the same country and industry or in other countries) will eventually recognize the strong competitive advantage that comes from disciplining product lines to match the highest quality relevant knowledge coming from an ever-changing science.

Set E.

1. As long as a person has a college degree and uses methodology that is fairly commonly applied in his industry, he has no responsibility (morally or legally) to establish that this methodology has a sound scientific foundation.
2. Even though a person is educated in the field, and the field uses methodology commonly, the individual practitioner has a professional obligation to determine by appropriate criteria that the methodology is morally and legally defensible, this obligation becoming most intense when large, expensive, hazardous sociotechnical systems are involved (such as the Challenger space vehicle, the Three-Mile Island nuclear plant, the Chernobyl nuclear plant, the Bhopal chemical plant, the Project Trilogy planning, the AT&T Net 1,000 communication system, etc.)

Set F.

PROPOSITIONS

1. A pattern of scientific irresponsibility has developed in large sociotechnical systems which, if not corrected, can cause incalculable harm to society.
2. This pattern is no different in principle than one that has long existed. In the past, the visibility of the pattern was less clear, and the consequences of correcting it were less threatening.
3. This pattern is not limited to particular areas in particular branches of engineering. Rather it is broad, exists in all areas, with differences occurring in the way it might be dealt with, because of variable infrastructure.
4. One area where this pattern obtains is in computer systems, and especially in software subsystems.
5. The pattern is most critical in those areas of sociotechnical systems. These areas are characterized by:
 - No clear responsibility for overall system concerns
 - Exploitation of the lack of widely-accepted discipline coming from scientific knowledge
 - Substitution of financial controls for quality controls on sociotechnical systems
 - Lack of leadership across the board
 - Numerous examples of catastrophic failures involving sizeable loss of life, sizeable loss of money, or combinations thereof; and a response that is typically characterized by two prevailing ideas:
 - i) This is a special situation, not part of a pattern, and requires only local correction
 - ii) Recurrence of this kind of situation is not likely in other jurisdictions

6. In the United States, the foxes are running all the henhouses. Financial people/^{or politicians}are controlling large sociotechnical projects, but have no insight into what they are controlling; and engineers are making decisions in the absence of responsible technical overview management that have no basis in science.
7. In West Germany, by contrast, the scientific establishment elects the leadership who are put in charge for 3 years of the federal appropriation, and who award funds to particular institutes that have missions and academic connections.
8. The professional associations and national academies exhibit no social awareness, do not report to the public, and cannot show any significant beneficial impact on sociotechnical systems. One of the reasons for this is that they do not have in their membership people with systems knowledge. But this is a symptom of a deeper problem, which is that they lack any clear concept of public trust in their operations, and are merely old-boy networks basking in the glory of their awards. They are not responsible to anyone.
9. The engineering establishment believes that design is an art, and that as long as the engineer can pass exams given by colleges or by professional engineering associations, they are qualified to practice; with only extremis policing by the associations, and that mainly of potential whistleblowers.
10. The fact is that design is at least as much of a science as any other science; that laws and principles exist which would prevent many major disasters, if applied; that these are sufficiently definitive that they could be used in court as a basis for prosecution of executives and irresponsible designers; and that the urgency of the current situation demands discussions begin on how to deal with this.

THE CONSEQUENCES OF NO SCIENCE

THE POTENTIAL BENEFITS OF A SCIENCE

- o A basis for making decisions
- o A basis for providing technical leadership
- o A basis for educational program design

HOW TO REASON ABOUT A SCIENCE

- o All science is partly wrong.
- o Science needs the three ingredients, and it also needs a clear reinforcement/correction channel
- o To see what the foundations should include, localize defects in applications and form the fundamental/symptomatic structure to sort out and salienate the situation
- o Can accept polyterps in fundamentals but then must put all sources in until confusion is cleared out
- o Foundations clearly have behavioral components and language components
- o Activity basis as well as technical knowledge basis-- the attachments coming from escalation
- o Can there be any question that all conceptual work involves some common features no matter ~~xxxx~~ what discipline is involved in doing the work
- o The pervasive is as important as the distinctive
- o Fields must excuse themselves from pervasive requirements by demonstrating why they are not pervasive in their discipline; the burden of proof is on them. Until they can do this (if ever), they must go with the generic as well as the specific

WHAT CRITERIA

- o for foundations
- o for theory
- o for methodology
- o for applications

PROPOSITIONS

Design research is being treated as though it is just like all other academic research; a matter for a few individuals to investigate to improve technique.

This approach to design research is totally inappropriate in the light of the current pattern of irresponsible design activity on a large scale in sociotechnical systems.