Lost In Translation: "Total Systems" From War Room to Boardroom

Thomas Haigh

Paper presented in November 2002, at the annual meeting of the Society of the History of Technology in Toronto as part of the session on "The Social Architectures of Cold War Electronics."

NOTE: This is the exact text as orally delivered. All citations and footnotes were stripped out for delivery. A longer version is under preparation for journal publication, and will be posted in due course. Thanks go to all those who discussed the paper with me and to the panel members – these comments are proving very helpful in revision.

Historians are only beginning to come to grips with the technologies of the cold war, and in particular with the central importance of information technologies to the development of the cold war and of the cold war to the development of information technologies. Two particularly important bodies of work have addressed these questions.

(Edwards Slide)

The first, Paul Edward's The Closed World placed the history of the SAGE air-defense network, one of the technologically most important systems in the history of computing, in the broader context of a distinctive cold war "discourse" of closed systems and cybernetic control. SAGE, the "Semi-Automated Ground Environment" involved the construction of a huge network of "semi automated" computerized command and control systems to automatically assimilate information relayed from many sources onto computerized display screens. This information would be used to scramble interceptors to bring down Soviet bombers. SAGE was the first major digital computer system to run in "real-time" – responding interactively to users and to external signals.

(Hughes slide)

The second, pursued by Thomas P Hughes in Rescuing Prometheus and his colleagues and students in the recent collection Computers, Experts and Systems defines a distinctive "systems engineering approach" that reached its zenith in the cold war projects of the 1960s. Hughes & Company suggest that the systems approach was reasonably coherent, marked a distinct departure from earlier practices, and originated in the operations research and logistics

work of the second world war. In early cold war aerospace project like SAGE (covered by Hughes as well as Edwards) and in the Atlas missile, the need to develop and integrate a host of unproven technologies spurred the creation of new administrative structures themselves engineered to support the project. Aerospace projects like Atlas demanded that different characteristics like range, weaponry, acceleration, accuracy, and so on be traded-off against each other so that the overall weapon system functioned optimally. The systems engineer, unlike the lesser engineers working on subsystems, was concerned with the "total system".

The cold war language of systems has attracted considerable historical attention in recent years. It represented the construction of a new kind of expertise, founded not on detailed factual knowledge of any single domain but on a more general understanding of the allegedly universal principles of cybernetics and simulation. According to its adherents, principles such as feedback and categorizations such as open system or closed system transcended their origins in engineering and underpinned biology, society, economics, business, and even psychology. Yet viewed in sociological terms, the actual realm of this systems expertise was far more specific. It surrounded the well-fed military contractors, the more forward looking of their compatriots in the armed forces and, above all, the water coolers and bulging foreheads of the air force non-profits of southern California. At the end of the 1950s, business was booming for the systems experts of the MITRE Corporation and the RAND Corporation. Their staff conducted research on machine translation, air-battle simulation, economics, psychology and a host of other areas.

These technocratic impulses were part of a broader faith among the educated elite of America, a faith that rational analysis and a practical yet intellectual approach to problem solving would soon render obsolete the differences in politics and ideology that had marked earlier eras. At the end of the 1950s the military-industrial-academic complex was young and full of hope for the glorious future that lay ahead. With the power of total systems seemingly proven in the area of high technology aerospace projects, the cold war systems elite set about exporting it to the rest of American industry.

My topic today comes from the 1960s attempts of a vocal and prominent collection of corporate specialists, consultants, computer vendors and business school professors to apply (at least rhetorically) the innovations of the cold war systems approach to the problems of corporate management. The result was a new concept, often called a Totally Integrated Management

Information System (MIS) or just a "Total System." Through the whole of the 1960s, the concept dominated all discussion of the managerial application of computers.

The administrative inclined community involved here were largely separate from the cold war systems elite of RAND and the aerospace contractors, and so their efforts form an interesting test-case for historians. Did a distinctive "closed world" discourse, of the kind discussed by Edwards, spread with MIS far beyond the technological cold war elite and into American society as a whole? Was a coherent systems approach, of the kind discussed by Hughes, transplanted far and wide?

(Early Univac advertisement)

Nobody reading the books, articles and conference proceedings devoted to corporate computing in the 1950s and 60s can miss the influence of the cold war and its space age technologies. One of these was a faith in the "blue sky" approach. Back in 1955, in an article revealing called "Decision Making in the Age of Automation", one General Electric representative made the emotional plea that without some kind of managerial automation "our thought process will be left in the horse-and-buggy state while our operations are being run in the age of nucleonics, electronics and jet propulsion." Advocates of MIS often used references to cold war technologies to back up statements like "They did not wait for new technology to develop… before they launched the program."

(Show pictures of "decision environment", give connection to SAGE)

Authors frequently justified their predictions with reference to the inevitable transfer of ideas and technologies from military to managerial use. It is clear that much civilian discussion of total systems was directly inspired by cold war systems such as SAGE. But to understand exactly what this means, and how deep the connection goes, we must look more closely at the systems men themselves.

The Systems Men

My earlier work focused on the "information" part of "management information system" and the emergence of modern ideas of information technology. Today I am more concerned with the "system" part of the concept.

(Bring up HBR paper slide)

Economic mobilization during the Second World War brought an incredible increase in industrial output and placed a premium on the integrated planning of production and distribution. Work simplification plans, printed forms, organizational charts, process charts, and instruction manuals were produced for use on an unprecedented scale. This wartime experience impressed many administrators with what could be accomplished when organizational structures and procedures were carefully crafted to achieve specific ends, rather than accreting slowly over time. In 1944, a number of these administrators met in Philadelphia and began the process of setting up a new organization that would further the acceptance of modern administrative techniques. The Systems and Procedures Association of America (SPA) received its charter in 1947. The members of the association called themselves the "systems men" – let me stress that I did not invent this term.

They aspired to true managerial power as the trusted assistants and advisors of top management. Their expertise was to be focused purely on the creation and improvement of systems and procedures. They considered themselves administrative generalists—indeed, "systems man" served as an overarching identity that subsumed existing specialties such as designing punched card systems.

(Cartoons go here)

Yet they were not always successful in making this claim. Too often they found themselves marginalized, "fighting fires" or continuing to work on specialized and tangible things like forms control rather than the general re-engineering of business procedures they craved.

To reemphasize this crucial distinction: the corporate "systems men" I write about usually worked as staff specialists at the corporate or divisional level, in the "methods" or "systems and procedures" groups of large corporations, mostly for civilian multidivisional industrial firms in the NE and Midwest. Some worked as consultants in general management consulting and accounting firms. They aimed to improve the efficiency and effectiveness of corporate administrative procedures, for example by simplifying billing procedures and integrating them better with inventory management. Their tangible expertise was in things like form design. In contrast, the military-industrial-academic cold war elite worked for think tanks,

government agencies and aerospace contractors (usually in S. California) on technological development projects and scientific studies.

It was the systems men who invented and promoted the civilian, administrative version of “total systems” and the management information system concept. The systems men first unveiled the concept known variously as “Management Information Systems” and “Total Systems” at a small conference on "Changing Dimensions in Office Management" sponsored by the American Management Association – a group devoted largely to managerial education, the hosting of conferences and the publication of resulting research. This meeting saw the first unveiling of the results of a working group called the Continuing Seminar on Management Information Systems. The group included senior representatives of IBM, consulting firm McKinsey and industrial giants such as Lockheed and du Pont.

It was, I have suggested, out of an interest in establishing real technocratic control over corporate systems and over the tangible powerbase of the newly-formed computer departments that the “management information system” or “total systems” concept was born.

Perhaps the most influential statement of the AMA conference belonged to Charles Stein, a consultant and member of the continuing seminar, who formulated the "integrated management information system" as a computerized tool that would meet the needs of all levels of management in a "timely, accurate and useful manner." Variations on this phrase were to appear hundreds of times over the next decade. While the lower levels of this gargantuan information system would process the payroll and bill customers, its upper levels would provide executives with interactive access to constantly updated forecasts and models of their company’s market position.

In the civilian administrative systems community, the concept spread rapidly -- encouraged by a spate of subsequent reports and conferences sponsored by the. In 1961, the conference program of the SPA was suddenly awash with papers on the “total systems concept.” Throughout the early 1960s, terms such as "management information system", "totally integrated management information system," “total systems concept,” "totally integrated data processing system," "totally integrated system," and "total system" were used interchangeably and ubiquitously by the systems men . The latter was the vaguest and initially the most popular, and

the early 1960s saw many papers and books devoted to "total systems". (By the late 1960s, however, most usage had shifted to "Management Information Systems").

An early book (called just "Total Systems") devoted to the subject introduced the total system as a "totally automated, fully responsive, truly all-encompassing information system embodying the collection, storage and processing of data and the reporting of significant information on an as-needed basis." For about a decade, from its introduction in 1959 to the end of the 1960s, this very broad concept of MIS spread rapidly and was endorsed by industrial corporations, consultants, academic researchers, management writers, and computer manufacturers.

An extreme and highly visual form of this can be seen in this series of advertisements for Univac computers, which ran in Fortune and Business Week in 1965. The sprawling corporate organization chart is compressed, symbolically, into a single reel of computer tape.

(Univac Total MIS advertisement)

The text on right reads "Your business with a Univac Total Management Information System. Management is no longer the remote apex of a pyramid but the hub of a wheel. Lines of communication are direct. Every area of activity is monitored on an absolutely current basis. And centralized control of decentralized operations becomes a reality. Painlessly…"

As I make clear in my earlier BHR paper, no firms succeeding in building grand, integrated MIS systems. But while a technical failure, MIS was a qualified success for the systems men. It bolstered their managerial profile, consolidated their authority over corporate computing and provided them with an attractive new identity. They went from saying effectively "Our expertise is form design and report control and procedures manuals and (a whole laundry list) to "our expertise is information system design" – and in doing so created the modern concepts of information system and information technology.

The 1959 SDC Conference

The meat of this new paper concerns the overlap of these administrative systems men with the better known cold-war elite systems community. Although I deal with several aspects of this in the longer version of this paper, I will focus here on contact in the seminal year of 1959 in which the MIS/Total System concept gestated.

I have been very pleased to discover, from this crucial year, the records of a conference held by cold-war systems firm System Development Corporation (SDC), at which its military-aerospace-academic systems experts met with key figures from the American Management Association group and a few of the leading administrative systems men of non-aerospace firms. SDC, a 1957 RAND Corporation spin-off and key SAGE contractor, identified itself as "The Total Systems Company" on its letterhead. Although SDC was, like its parent, a not for profit corporation, it was created explicitly to develop and build SAGE and future large-scale systems; whereas RAND itself was often said to stand for Research And No Development due to its theoretical bias. Done properly this development work was a lucrative business, and the first waves of what would eventually be a $150 million tide of cash flowed in from the SAGE programming contract, SDC began to look for additional projects and alternative sources of funds. Its growing interest in the application of its techniques to management seemed to coincide happily with an abundance of surplus cash and a public-service mission to spread the findings of the new "systems sciences" to new areas. These projects consumed its excess income while shining its public image and laying the groundwork for future contracts. The conference marked the start of a planned research program to which SDC publicly promised to devote half a million dollars per year for the indefinite future.

SDC was inclined to overestimate the applicability of its existing work to the construction of general purpose, civilian management systems. M.O. Kappler, President of SDC, suggested that because SAGE, "connected to… automatic data inputs" and presented information on the "operation while it is in progress" they had an important role to play in business. "In developing military systems," he said, "we have learned to provide aids for decision making. The problems in business should be amenable to a similar approach."

This looks, at first glance, like a smoking gun left for the cultural historian. SDC is the "total systems company" – and for years after the meeting, "total systems" – unknown before 1959 -- was the hottest buzzword in corporate computing. SDC had built the SAGE software, and now it wanted to do the same for corporate management. But the transcripts of these discussions provide something almost the opposite of a smoking gun – maybe a huge cannon packed with power and shot that somehow failed to go off. A damp squib. SDC's hopes that its SAGE expertise could translate directly into the reinvention of corporate management were not taken seriously by the corporate participants.

This conference was really the closest the two groups were ever to get to each other, and captures that happy time when a dramatic and far-reaching new approach has been proposed but not yet really tested. Its organizers were among the most industrially-oriented members of the SDC community. The main conference coordinator, Donald G. Malcolm, was past-president of the American Institute of Industrial Engineers, a veteran of General Motors and former head of Operations Research for consulting firm Booz, Allen and Hamilton – in which capacity he designed the hugely influential PERT project control system for the Navy's Polaris program. In the context of this conference, Malcolm must have appeared a bridge between the mathematically oriented, scientific world of SDC and the grubbier realities of practicing administrative systems men. Likewise, the administrative systems men in attendance were disproportionately likely to hold scientific degrees, work for aerospace firms and speak the language of cybernetics.

Nevertheless, several areas of disagreement between the two camps were apparent. One of these was the contention by the more fervent operations research enthusiasts that fundamental breakthroughs could come only from scientific work under laboratory conditions. Alan J. Rowe, a former academic and head of the SDC Management Controls Research group, conceded that "interaction with the real world" might "possibly" produce useful thinking. He insisted, however, that this could never produce the "fundamental laws" required. "What is needed is fundamental research where one can test hypotheses through experimentation. Further, I can't see how this experimentation can be done in the real world." This thinking, clearly, fits right in with Edward's discussion of the "closed world" nature of SAGE thinking. This effort would start with rapid simulation on computer – only later would data from real firms be gathered to validate and enrich the model. This was a very RAND way of approaching things.

At this point the grumbling began. A typical objection came from H. Ford Dickie, a senior administered systems figure at General Electric. Dickie argued that to wait a decade in hope for fundamental breakthroughs and optimal solutions would be foolish when there were practical tools available today. He called for "smaller, cleaner projects" because "the motivation is greater, the results more quickly useful, and the ideas more easily conveyed to operating management." Dickie was no systems skeptic – in fact he agreed that application of "the kind of technique RAND and other organizations have devoted to military systems problems" was vital for GE. He saw the computer as a fundamental part of this transformation. "true integration", he

said, “should follow lines of information flow; it should cut vertically through all functions in a product line... by having all the information processes linked together inside the computer." But even Dickie felt that attention would be better paid to incremental improvements and applied work than to abstract models.

While most of the conference speakers threw around the language of automated control and pondered the merits of closed and open loop systems, they were hard pressed to map these lofty ideas directly onto the actual activities of top management. “Management control”, the theme of the conference, was a phrase which appealed primarily to the militarily and academically inclined participants. Warren E. Alberts, VP of Industrial Engineering for United Airlines, was uncomfortable with a too literal translation of military control concepts.

(Alberts diagram)

As this diagram shows, Alberts was himself a great believer in systems as a managerial philosophy ready to transform top-level corporate management. It is very cybernetic, somewhere between an organization chart and a flow chart. The box, next to the top, labeled “Corporate Laboratory – Test, Plan, Forecast” was clearly intended as an evolution of his own group, and would have represented an enormous increase in responsibility.

Picking up on the cybernetic underpinnings of the ideas being thrown around, Alberts suggested that:

> we might compare business to a missile. We can think of the thrust section as the operating organization, the programmed section as the plan to hit the target or goals, and the nose section as the control system. But now we run into some real differences. First, management is not sitting in any bombproof control section, but is riding with the missile; second, the thrust section, a man-machine organization, is extremely variable and dynamic. In addition, the real target is never seen, only sensed, and its position is only guessed at.

Crucially, Alberts observed that the “term 'control' in management control systems is easy to use but hard to define. It has unfortunate reactions when transferred too literally from physical to human systems. A better term to use would be 'information' in place of 'control' so that we can concern ourselves in a positive fashion with the total communication interchange

within a business organization." It was one thing to inform managers, and quite another to control them.

“Totality” was an essential goal in a systems engineering project, such as the Atlas missile, where functional specifications could unambiguously describe the performance of the system as a whole and the results of trade-offs at the component level could be scientifically evaluated. This kind of systems engineering was well suited to high budget, urgent military research and development projects. But discussions of the kind conducted at the SDC conference show that the application of these engineering project management techniques to the general setting of corporate strategy was not so much unsuccessful as impossible – nobody could figure out what the system was, or how to represent its goals.

“Total systems” was both the motto of SDC and the hottest buzzword in administrative systems conference and consulting sales pitches of the early 1960s. Yet the meaning of this language was essentially lost in this translation. Some early definitions of "total" administrative systems preserved the original systems engineering sense: totality meant that processes were coordinated and decisions evaluated according the interests of the firm as a whole rather than the parochial concerns of different departments. This was apparent at the SDC conference, when Rowe argued that this was particularly important because lower levels of management "are not in a position to see how their actions affect the performance of the system as a whole." Kappler then boasted that SDC had already achieved this tricky goal with its System Training Program for SAGE -- "the way to fight it is to be sure that the team result is visible to the one who is suboptimizing. He must see how his actions affect the total system."

However, as the phrase percolated though the broader systems and data processing communities, these definitions were soon crowded out by the idea that a “total" or "totally integrated" system was simply a system that had everything in it. The standard definition, as we saw, became a system that supplied all information required to all managers, everywhere in the corporation, instantly.

That is just one example. By a very similar process, “systems analyst” went from being the title of an elite RAND defense intellectual to a title given to anyone involved in planning and specifying an administrative computer program. By the 1980s, the title was routinely granted to senior programmers with no responsibility for business analysis at all.

Real-time systems, of the kind pioneered by SAGE, did win a small corporate niche for application such as the famous SABRE airline reservation system of the early 1960s. But they were enormously expensive and extremely inflexible. They found some operational applications, but – until the recent past at least -- no strategic or policy related ones of the kind imagined by advocates of the total systems concept.

SDC's own attempts to reinvent management as a science were not a great success. After the 1959 meeting it appears to have scaled back its ambitious plans. It did pursue civilian contracts in areas related to its actual technical expertise, such as a command system for the LAPD, but found budgets tighter and customers less indulgent in this area. In the mid-1960s, SDC achieved great things in its research program to produce on-line database management systems, but its attempts to commercialize this technology for managerial use proved totally unsuccessful owing to the expensive and unfamiliar nature of the technology and its cultural inability to effectively market its products to administrative data processing operations.

Conclusions

From a distance, this looks like an open and shut case of the transfer of cold war technologies, cultures, and "systems thinking" from the elite military industrial complex to the more humble world of corporate administration. Yet looked at more closely, the question of exactly what is being translated becomes highly problematic. Rather than one systems community, spanning both spheres, I found two separate groups with different origins, aims and cultures. They were united only through their shared use of an exceptionally malleable set of systems-related ideas. Indeed, I would suggest that it is precisely the fuzziness of these Cold War systems concepts that explains their rapid spread.

To adapt a famous quip about our two great nations (no Canadians here are there?), one might speak of the cold-war military-academic systems elite and the administrative systems men as "two groups divided by a common language" – in this case the language of systems closed-, open-, total- and control-. To understand the more local meanings given to these cold war concepts, and the interests they serve, we must find ways of integrating study of the elites of the cold war military-industrial-academic complex with the social history of the many other groups interacting with cold war ideology. In this case, it demands attention to neglected questions of identity and authority within the ranks of corporate managers and staff specialists during the

post-WWII period.

The totalizing discourse of the cold war was not, for them, a force of intellectual enslavement but a grab bag of resources upon which they could draw in a kind of conceptual entrepreneurship. These ideas included SAGE as a proof of technological principle, the state-of-the-art allure of military technology and the "blue-sky" thinking that rushed unproven technology into rapid deployment. It also provided them with a rhetoric of modernity focused on "systems", general faith that automation was inherently good and efficient, and acceptance of the idea that instant electronic information would lead to better decisions.

Direct transfer from war room to board room, of the kind attempted by SDC, was not successful. Instead, the administrative systems men borrowed some of the allure accruing to these ideas, and to military command and control systems, but used these ideas to their own pre-existing ends. The issues involved, such as clashes between managerial and technical claims to authority, and the role of systematization in building managerial legitimacy, go back much further, to the engineering reformers of the progressive era and the systematic management pioneers of the nineteenth century. Ever since Taylor, technocratically inclined systematizers have struggled to establish the authority of their own, putatively universal, expertise over the better demarcated domains of general managers. The cold war provided the background against which the latest act of this drama was played out, many of the props and some of the dialog. However, neither the stage itself, nor the plot, were really very original.