WEAPONS TO WIDGETS: ORGANIC SYSTEMS AND PUBLIC POLICY FOR TECH TRANSFER

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ABSTRACT

Large cuts in defense spending cause serious repercussions throughout the American economy. One means to counter the negative effects of defense reductions is to redirect federal dollars to temporarily prop up defense industries and, over the longer-term, stimulate growth of new non-defense industries. The creation of non-defense products and industries by channeling ideas from public laboratories into the private sector manufacturing facilities, known as technology transfer, is being undertaken in a massive program that has high visibility, large amounts of money, and broad federal agency involvement. How effectively federal money can be directed toward stimulating the creation of non-defense products will define the strength of the economy, (i.e., tax base, employment level, trade balance, capital investments, etc.), over the next decade. Key functions of the tech transfer process are technology and market assessment, capital formation, manufacturing feasibility, sales and distribution, and business organization creation. Those, however, are not functions typically associated with the federal government. Is the government prepared to provide leadership in those areas? This paper suggests organic systems theory as a means to structure the public sector's actions to provide leadership in functional areas normally outside their scope of expertise. By applying new ideas in organization theory, can we design government action to efficiently and effectively transfer technologies?

INTRODUCTION

Technology transfer is expected to revitalize the economy. At the federal level we have dedicated sizable programs and 10-20% of the federal research and development (R&D) budget to that effort. The question I wish to raise is whether we have structured our organizations to accomplish that goal? Or, will we diminish our outcomes because we have not given close attention to the organizational structures to facilitate technology transfer? This paper will make

observations about technology transfer processes and suggest that organic systems theory will help us organize ourselves to succeed.

PERSPECTIVES ON THE ISSUE OF SYSTEMS THEORY AND TECH TRANSFER

This segment of the Dual Use Technology Conference is designed to investigate, "Technologies for Technology Transfer," and this particular session is "Business Processes and Technology Transfer." My comments are based on the premise that our most valuable technology is our pool of human resources. How those resources, the *people* involved, are directed is unquestionably a matter of management, and management is changing. Effective management is no longer considered to be quantification-centered. Nor is it based on endless planning and forecasting. After decades of measuring *everything*, we have learned that our world is complex, forecasts are usually wrong, and detailed plans are nearly worthless nine months after they are completed. Far too many managers find it safer to demand "quantified certainty" than to make operational decisions. After all, if the numbers add up, the manager can't be faulted even if there is a bad outcome. And, if the bad outcome is proved to be unforeseen, then the manager is innocent -- or so goes traditional thinking. In fact, managers are guilty of wasting time, money, and perhaps worst of all, they work in organizations where it takes great courage to make decisions. The results of the traditional management approach are well known: disappointing productivity, difficulty in meeting foreign competition, and a shrinking manufacturing base.

However, progressive organizations have begun to retreat from the traditional MBA -- quantitative -- methods. What must evolve in order to fill that vacuum is a revised paradigm based on experience and research. Organic systems theory may be the answer. It builds on a substantial body of knowledge about systems, yet is updated to correct the faults of the traditional machine systems theory. We now understand that we are not simple cogs in a machine system, rather we are like complex cells or organs in a large dynamic organism, subject to all types of external and internal stimuli. Although there is a level of predictability to our functions, it is by no means certain.

THE ESSENCE OF THE ALTERNATIVE

Peter Senge has written an important book on this transformation in management thought, *The Fifth Discipline: The Art and Practice of the Learning Organization.* Senge proposes that organizations have the capability to unlock enormous potential in creativity if they can observe the whole system in which the organization operates. He writes:

> The essence of the discipline of systems thinking lies in a shift of mind: seeing interrelationships rather than linear cause-effect chains, and seeing processes of change rather than snapshots (Senge, p.73)

He goes on to explain,

> Systems thinking finds its greatest benefits in helping us distinguish high- from low-leverage changes in highly complex situations. In effect, the art of systems thinking lies in seeing trough complexity to the underlying structures generating change. ....What we most need are ways to know what is important and what is not important, what variables to focus on and which to pay less attention to -- and we need ways to do this which can help groups or teams develop shared understanding. (Senge, p. 128)

Shared understanding is precisely what is troubling about the sudden emphasis on technology transfer for many government agencies and workers. Do they have a shared understanding? Buckminister Fuller spoke of our ideas being two hundred years ahead of our social development. What he meant by that was that we have the capability to do more than we do. What impedes our progress is that humans avoid change and this is clearly built into our species. It is as much genetic as it is cultural. Unlike other animals, we spend years with our dependent offspring before they go out into the world on their own. That in itself is a major contributor to a pattern that slows social and cultural change in organizations.

When we institute a major change in the way a large organization like a federal agency operates we must account for these patterns of human behavior that affect the process of change. Organic systems theory can help us create mechanisms within the organization that ameliorate the negative aspects of resistance to change and speed the assimilation of new ideas. This technology for technology transfer is a methodology for thinking about the task in terms of the organization and

its members. The important search is for appropriate structures and processes within the organization that will lead to fulfillment of our goals.

ISSUES INTERNAL TO THE TECHNOLOGY TRANSFER PROCESS

There are four major internal problem areas facing the technology transfer process that I believe can be successfully addressed through organizational and process change:

1. **PERSONNEL**: Federal lab staff and scientists, to date, are not thoroughly committed to tech transfer tasks of commercialization. There is not wide-spread experience with or a commitment to technology identification and assessment for commercialization, CRADA development, and solicitation of industry support for transfer of technologies.

2. **CONTACTS AND ACCESS**: Relatively few commercial enterprises are "plugged-in" to federal labs to the degree that they can efficiently gain access to available ideas, or work through the process of development.

3. **CAPITAL**: Capital is not available in the quantity necessary for most small firms to sustain the technology identification, assessment, and R&D process to bring an idea out of a federal lab.

4. **BUSINESS EXPERTISE IN LABS**: Federal agencies do not have sufficient expertise in manufacturing and market assessment, finance, or sales and distribution to assist commercial firms with those functions. Consequently, it is hard to advise or know what is commercializable.

Leadership in the technology transfer process whether it be agency-level or from Congress can define the organization and process of tech transfer to eliminate these areas of weakness.

SYSTEMS THEORY AND PUBLIC POLICY

What can be done? First, it is clear that public policies will determine the nature of the technology transfer initiative. The task we face is to enact policies that will maximize the effectiveness of the transfers. It is imperative that we look at the whole environment if we are to successfully employ systems theory to this issue. For example, the technology transfer program within the Department of Defense (DoD) and NASA is part of the larger policy outline framed by the broad national objectives of:

1) protecting our national research capabilities,

2) preserving the industrial capabilities of our defense contractors,

3) stimulating growth in the manufacturing sector to create jobs to off-set lost defense/federal jobs,

4) regaining national competitiveness in the global marketplace to help correct a serious trade imbalance, and

4) stimulating the economy to create additional revenues from tax receipts to reduce the federal budget deficit.

Second, those objectives cannot be met through a single program within one agency. On the other hand, they can be met by a systemic approach that includes coordinated programs within a variety of agencies and with modifications to existing legislation that runs counter to national objectives. For example, the Technology Reinvestment Project is an undertaking coming from the Defense Conversion, Reinvestment, and Transition Assistance Act of 1992. The solicitation for proposals came from the Advanced Research Projects Agency (ARPA) representing five different agencies (DoD, Commerce, DOE, NSF, and NASA). This is a good example of a coordinated effort among five agencies, leading directly to the transfer of technologies. However, are policy-makers developing other coordinated programs that address the other national objectives and tie together the related activities across the government? In the macro-view, have Congress and the Administration clarified their policies so that other critical agencies are operating in supportive roles? Is the Internal Revenue Service involved? Have tax laws been changed to place emphasis on capital investment in plant and equipment? Do capital gains taxes encourage investment? What will the Department of Labor's role be in direct support of the tech transfer initiative. Have the Treasury Department and the Federal Reserve made policies that will free capital through instruments of debt?

Similarly, in the micro-view, we can address the four internal problem areas mentioned above; 1) personnel, 2) contacts and access, 3) capital, and 4) business expertise in the labs. Beginning with personnel, have position descriptions and mission statements been rewritten to reflect the

changed objectives of the organization? The incentives built into the Technology Transfer Act of 1986 provide for personal remuneration from lab activities but do not effect everyone involved in the process. Although such policies have generated change, it is a lengthy process and requires commitment from leadership and ongoing reinforcement in personnel policies; promotion decisions, award programs, and, if necessary, penalties for those who do not accept the changing mission of their agency.

Are contacts fostered by public programs? Is access truly encouraged? Not long ago I attended a multi-day event put on by one of the military services to help introduce business to the availability of technology and to encourage cooperation between the federally sponsored research and the manufacturing community. Immediately following a warm welcoming appeal to the audience by the General Officer in command of the laboratory he was whisked away to other "important" business. He was followed by a civilian presenter from the contracting office who made it very clear that no matter who you were or what technology you wanted, if you didn't have "his" forms filled out properly, there was no way you would be awarded a contract.

The message we in the audience understood was that in the next two days we would hear only more baloney, and only those insiders with experience in the system would be able to weed through the bureaucracy. Can such a break-down be fixed? Certainly, but it takes time and considerable effort. Obviously the contracting officer hadn't gotten the message and, one can only wonder whether the commander was sincere in his invitation to work with them, since he only attended the program long enough to hear himself.

Although capital availability is primarily driven by tax law and Federal Reserve Policy, in this context, through programs such as the Technology Reinvestment Project and the Small Business Innovation and Research (SBIR) Program, small amounts of capital are controlled at the agency-level. Within those Departments of government, do we have the best possible structure and system in place to direct tech transfer money? Are the evaluation and award processes most effective at transferring technologies or are SBIR funds, for instance, used as an "off budget"

means of pursuing insiders' pet projects? Is it necessary for this process to be administered in house? Are the awards objectively made when lab personnel provide the evaluation and make the awards? Or, would the process be better if an outside, rotating, panel of scientists and business persons was formed to review and recommend awards for approval by a top agency administrator who would be publicly accountable? Is it possible to build a checks and balances protection into the system that awards millions of dollars rather than keeping the process in the hands of the same people who have interests in certain technologies, personal ties to "insiders" and little accountability for long-term outcomes once the grants are awarded?

CONCLUSION

Public policy that directs technology transfer efforts throughout the federal laboratory system could benefit from the application of systems theory. The weaknesses in the present structure described above are not serious flaws as organizations go. But without correction, the potential exists for technology transfer efforts to be undermined from within and to remain of limited benefit to potential inventors, manufacturers, and investors who are positioned to make a difference in the American economy in the coming decade. I propose that leaders in this Administration and in Congress evaluate the current technology transfer process and question its validity from a systems theory perspective. Further, those at every level in the system can do likewise. I am confident that improvements can be made and that the pay-off will be significant.

Research for this presentation uncovered titles that may provide a warning. (For example, "Let's Improve Technology Transfer," "Perry to Ruffle Feathers to Preserve Defense Industrial Base," "NASA's Controversial Quest for a Broader Mission," and, "Is Technology Transfer a Flop?") However, what we do with the enormous potential we have available from the outstanding work of the scientists in the federal laboratories will make a significant difference in the way we live and in the way our children fit into the shrinking world of the twenty-first century. We should take advantage of the technologies we have at our disposal -- *all* the "technologies," including organization theory. Let us use organic systems theory as we formulate our public policies to

plan organizations that can unlock the creativity and potential of our human resources. We have much to gain.

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