Date: June 30, 1970
From (location or U.S. mail address): Armonk
Dept. & Bldg: 3A-59
Tieline & Tel. Ext.: 10-608
7564

REC'D — PALO ALTO
JUL 6 1970
SCIENTIFIC CENTER

IBM

Subject: Attached Commentaries

Reference:

To: IBM Fellows
Dr. E. R. Piore
Mr. G. F. Kennard

Steve Dunwell has requested that the two attached commentaries be distributed to you:

SIRVIVAL VALUE OF ORGANIZATION MYTHS
J. Brownlow

DECOMPOSITION OF LARGE INTERLOCKING ORGANIZATIONS
R. Landauer

J. E. Milano

JEM:dec
Attachment

cc: Dr. J. E. Bertram

DECOMPOSITION OF LARGE INTERLOCKING ORGANIZATIONS

C. Conti, in his talk, pointed out that to test the ability of n program modules to interface with each other requires the test of n^2 interfaces. In fact, Conti went on beyond this to consider alternative possible time sequences which he estimated at n! This rapid growth of interfaces is of course not really necessary and brings to mind some rather general points which occur whenever we try to separate complex interlocking organizations into specifiable and testable subcomponents. The problem is common to large business organizations as well as to hardware and software systems. Unfortunately, a fundamental consideration of the most basic alternatives available in the decomposition process is seldom raised explicitly until long after the system has become well established.

The basic point: We do not need to interconnect all components of a system directly with each other but instead we can deal with a hierarchy. In the business organization this is represented by the organization chart. In the telephone system the hierarchy consists of a series of exchanges. The telephone is connected to a local exchange, the local exchange is connected in turn to a central exchange, and thus we avoid the necessity to interface all telephones in the country or in the world directly with each other. The basic decisions that have to be made in cutting up a system concern: 1) the number of levels in the hierarchy, 2) the distribution of control within that hierarchy.

It is helpful to take the telephone system, where control is left to the lowest level and contrast it to the computer (or the computer corporation) where control is generally reserved for higher levels. In a telephone system, for example, at least when it's working right, the telephone user controls the destination of the message, the control is not left to the system that provides the interconnection. By contrast, in the computer hardware organization we take standardized modules and interconnect them through higher levels of packaging which in turn really determine the computer function. Similarly when we write a program and interlink modules, we typically call for subroutines and the overall function is controlled by the linkage mechanism, not by the individual subroutines. Not all possible distributions of control are possible for all the tasks one wants to do. A complex task does require coordination, it cannot be completely controlled by its elementary subtasks. Nevertheless, there seems to be more flexibility available than we usually acknowledge. Thus, for example, in the hardware system we typically connect each elementary logical function through its own wired physical channel to some other gate elsewhere in the computer. Thus, except when addressing memory, we invoke one physical channel for each information channel. That doesn't really seem to be necessary. One could visualize introducing more of the telephone system and multiplexing the use of physical connections. An integrated circuit, chip, or module doesn't really need one physical terminal for each logical input and output. Multiplexing and demultiplexing (or addressing) can be done on the chip as it is already done in the case of memory chips. This might decrease the complexity of packaging, and also ease the pin limitation problem. A reason for lowering the level of control in a hierarchy comes from the fact that systems with a more decentralized control permit more graceful degradation and also permit more graceful evolution.

The currently evolving experiments in computer networks seem particularly important since they are an attempt to tie computers together without forming a centrally controlled multi-processor. It is hard for us

to think about such systems and this, in turn, accounts for the fact that computer network proposals generally leave a critical reader with the question: "Yes, but how is it really going to be useful?" The lack of a good answer to that question shouldn't stop us prematurely.

The need for standardized subunits, testable and specifiable, has long ago become established in the hardware world. It is accepted there that, for the sake of standardization, the elementary module cannot be optimized for the particular purpose in hand, the designer must live with a combination of what the CD catalog provides. We have also learned, through the advent of LSI, that as the basic functional unit increases in size, it gets much harder to define a sensible library of standardized modules. The software world, despite an obviously rampant growth of complexity still treats the testable and specifiable standardized component as a subject for occasional lunch table discussions. Is this reasonable?

The late Asher Opler, in an eloquent memorandum dated November 25, 1968, took up the cudgels for standardized software components, but apparently without much success. One systems expert,whose judgement I greatly respect, recently argued against standardized software modules on the basis:

(1) We do not know enough to define general modules. A very large percentage of the code (and complexity) is due to special cases and it does not seem possible to generalize them.

(2) We have not been able to write a good, high level system programming language. The addition of the requirement of finding and using standard subunits makes this even more difficult.

I am afraid that these objections sound a lot like the objections to integrated circuitry before that concept had become accepted in the computer community. In fact if we carry the standardization far enough, we may achieve the freedom to achieve a function in software in one system and the same function in hardware in another system. As an example consider a Fourier transform. One would then envision the same high-level program, which in one machine would activate a special array processor, and in another would simply call for a subroutine which depends on ordinary CPU capabilities.

Rolf Landauer
5-21-70

RL:mm

SURVIVAL VALUE OF ORGANIZATION MYTHS

I have tried to diagnose the human community known as IBM and have found the point of view of an anthropologist as being the most satisfactory for me. I mean that the ethical, sociological, economic and technical viewpoints, while being more analytic and rationally pleasing, do not, one at a time, adequately explain our present condition or what we can do to improve our chances of survival.

From the anthropological point of view one can assign to the specialized activity, the compartmentalization of function, the conflicts, the collaborations, the rituals, the response to troubles and crises, a survival value or a cultural function. A complete assignment is a social theory, this is difficult to build for a tribe and may be impossible for a complex society like IBM.

Yet, I make an assumption that each member and each community component of IBM operates in a purposeful way using its own distinct "theory" of IBM. The misunderstandings, "poor" planning, "poor" response to crises arise because of the distinctly different myths or "theories" held by separate groups in the organization. In a competitive, success oriented society this condition seems to be natural. In a tribe of mutual support and common holdings, there is only one tribal myth and it is a highly self consistent science or set of sacred teachings and rules that guarantee the survival and supremacy of the tribe. The only important conflicts are with nature, infertility, disease or with the external threats of alien myths and peoples. They are tuned to a spiritual rhythm, we are tuned to impersonal, technical oscillations of "systems."

One weakness that deserves our attention is the disabling effect of internal conflicts and dissent. I don't favor the elimination of conflict. I think it has made possible science, technique and complex administration in western cultures. I mean the end to the traditional denial of problems of morale, poor decisions and over control, that fall out of our closed myths and own institutionalized responses to conflict. I see a need for dealing with our social concerns inside our company. This need is congruent with our need for expression of social concerns external to the company. A reactivation of widely distributed native social skills is possible. It is possible to expand our competence to face social and personal issues in conflicts, to examine our goals openly with each other, to be socially creative as a community. Informal social machinery is taking us in unknown directions, it is seeking a spiritual rhythm. To manage it with imagination means to coax some of those forces into play in the formal social machinery of participation and control.

Our overconfidence in the man-manager relationship has blinded us to the realities of community and group sentiments and forces. It excuses business

as usual and fosters the feeling that ethical codes can regularize our social concerns. Over reliance on inter-group and inter-division competition is also a weakness. The social and ethical reverberations of the many technical or business contests are not dealt with in a competent community way. Third parties and the company interests are not respected in some of these contests. Our social creativity is not rewarded by community approvals.

I don't have a final solution. If we have internal social concerns I suggest we hire a consultant team who is competent to diagnose our problems. (Naturally, I would pick a team who looks at problems as I do.)

An alternative suggestion is to give encouragement to impulses and innovative suggestions for internal social change. Let them grow, reinforce each other and fuse with tradition to produce better approximations. We can attempt to keep our technical and corporate myths open to change.

Tests for success along these lines would be an elevation of internal mood and a clamor by outsiders to get into this community because it promises a great human experience, their evidence being the report of insiders. These results would be our reward for social creativity. Maybe this concept of a community could be looked on as another utopia, but one which leaves the question of business survival unanswered.

J. M. Brownlow
June 9, 1970

cs