[Keynote]

Enhancing Organizational Intelligence Through Effective Information Systems Management

From an Address Delivered at EDPA '88, The Asia Pacific Conference on Information Systems Audit

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Preface

Dr. Matsuda's fine presentation, Enhancing Organizational Intelligence through Effective Information Systems Management, covers many areas which are often neglected in the auditors assessment of information systems. He considers the various factors which affect organizational learning, intelligence, information handling performance, and resource allocation. Dr. Matsuda points out that organizational decision making is really based on “bounded rationality” in that organizations normally have neither the time nor the resources to make decisions based on all the information but in fact have limited information which "satisfies” the organization’ s objectives. He proposes that auditing expand its role to examine selected strategic points related to enhancing the organization's overall intelligence. This includes looking at opportunity costs. Assuredly, improving organizational intelligence should improve market share and profitability.

I suggest that to meet Dr. Matsuda's proposal, the whole organization must support the recommended new role of the audit function. Further, the audit staff needs to develop an indepth knowledge of the business including business opportunities. Organizations are notorious for maintaining their status quo long as they are meeting their expectations. Those organizations whose culture supports change and innovations are probably the best candidates for Dr. Matsuda's suggestions.

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My paper will cover the following elements:

First, an overview as to what sort of phenomena might take place in the future informationalized society is presented, by way of providing the general perspective for management and, in particular, for systems audit in an organization of the coming age.

Second, a brief discussion of what I call "organizational intelligence" is given. It is not what CIA or espionage agents might connote (Wilensky[6]) , but is the collective intellectual capability of an organization, crudely analogous to individual human intelligence, in handling its problems.

Third, what I mean by effective information systems management is proposed and it is then related to improvement and innovation of the management of an organization due to

advanced organizational intelligence.

Finally, some new concepts that might be useful for the future systems audit are proposed, especially with their contribution to management in mind.

1. Some Aspects of the Highly Informationalized Society

1.1 Information Superabundance

As we have already been experiencing, a deluge of information surges these days. Three types of problem would seem to be awaiting solution.

(1) **Relevance**

Some filtering is necessary to distinguish what is relevant from what is irrelevant.

(2) **Consistency**

Appropriate collating is required among possibly inconsistent, or even contradictory, multichannel information.

(3) **Manageability**

Some condensing mechanism is essential to reduce the quantity of information to be handled to a manageable size.

1.2 "Time-Space" Revolution

Informationalization is revolutionizing the notion and the meaning of time and space.

(1) **Runaway Advance in Information Technology**

Nobody seems to know how far it is going and how diversified it will be.

(2) **Value of a time Getting Critical**

A momentary delay could be fatal to an organization. On the other hand, seizure of the moment might bring a favorable opportunity.

(3) **Shrinking Space**

Developing telecommunication technology, in addition to the progress of means of transportation, is making the world smaller and smaller.

(4) **"Cost" of Being Left Behind Getting Grave**

This "cost" is not recorded and measured within the ordinary framework of accounting. It is an "opportunity cost".

1.3 Networking Revolution

As the information technology (computer and communication) advances, decision points are getting more and more interconnected both intra-and inter organizational ways.

(1) **Global Networking**

As the operations of organizations become more and more international and the telecommunication technology advances so far and fast, information networking takes on a global scale.

(2) **Security**

For any global information network, serious difficulties foreseen are computer crime, circuit breakdown, fire, earthquake, and so on, and sufficiently preventive measures are indispensable.

(3) **Control**

Needless to say, it is definitely required for any information network to preserve the specified conditions of operation, and some appropriate control mechanism must be built in.

(4) **Privacy Protection**

This is essentially a part of the security problem, but it would seem to be creating some social problems of its own.

(5) **Evaluation**

The global information network would seem to be posing some new types of problems in case of any breakdown accidents such as

a. Responsibility sharing, and
b. Opportunity loss evaluation.

1.4 Information Disparity

Although information is rich and even abundant in the informationalized society, it may not be evenly distributed.

(1) **Maldistribution of Information**

Even if the overall volume of information becomes larger in any informationalized society, useful information may be very partially distributed. For instance, limited group of people within an organization may

be monopolyzing the important, key type of information.

(2) **Information Gap**

As information technology advances, difference in terms of both quality and quantity of information would seem to tend to be larger between informationally advantageous and disadvantageous groups in an organization.

(3) **Information Alienation**

Such an informationally disadvantageous group would experience the feeling of information alienation, and this in turn will cause loss of motivation and consequently low performance.

(4) **Power Concentration**

On the other hand, power within an organization may concentrate in the hand of the informationally advantages group, and this may create undesirable power politics in the organization.

1.5 "Sentimental" Aspect of Information

The Japanese expression, " jo-ho" for the term "information " contains the following two aspects:

i. "jo", which represents the tacit and "sentimental" aspect, and

ii. "ho" which represents the articulated and "factual" aspect.

(1) **Prevalence of "Factual" Information Systems**

Most of the formal information systems in an organization, inclusive of the computer systems, are almost exclusively concerned with the "factual" kind of information. Such information is being handled with higher and higher precision and faster and faster speed. The level of sophistication of "factual" information systems would seem to be constantly being elevated.

(2) **Existence of "Sentimental" Type of Information**

There is, however, another type of information of great importance; namely, the tacit and sentimental type. This includes information on value, opinion, feeling, and so forth, which would usually be handled by informal systems, mostly in the form of face to-face communication, soliloquy, facial expression, etc., and naturally escapes from the formal network of factual information.

(3) **Possible Winning Trick for Management**

The important point is that in the Japanese organizational situations the vital managerial decision such as to affect the destiny of an organization would sometimes seem to be made on the basis of the very informal, tacit, sentimental type of information. Now that the information technology has been so much advanced and that anyone if he wishes could have access to sophisticated factual information, the real winning trick for management might possibly consist in the wise use of tacit, sentimental information.

2. Organizational Intelligence in the Information Era

2.1 Organizational Intelligence Provisionally Defined

(1) **Problem-Handling Orientation**

By analogy with an individual human intelligence, organizational intelligence might provisionally be defined as the collective, intellectual problem-handling capability of an organization as a whole.

Then, organizational intelligence might be interpreted to manifest itself throughout the problem-handling processes (Fig. 1) such as:

i. Problem cognition

ii. Problem formulation

iii. Problem-solving

iv. Solution implementation

More concretely, it would be observed in generating every endogenous behavior (demonstrated by ▭ in Fig.1) in the problem-handling process.

Effectiveness of information systems management will affect the functioning of

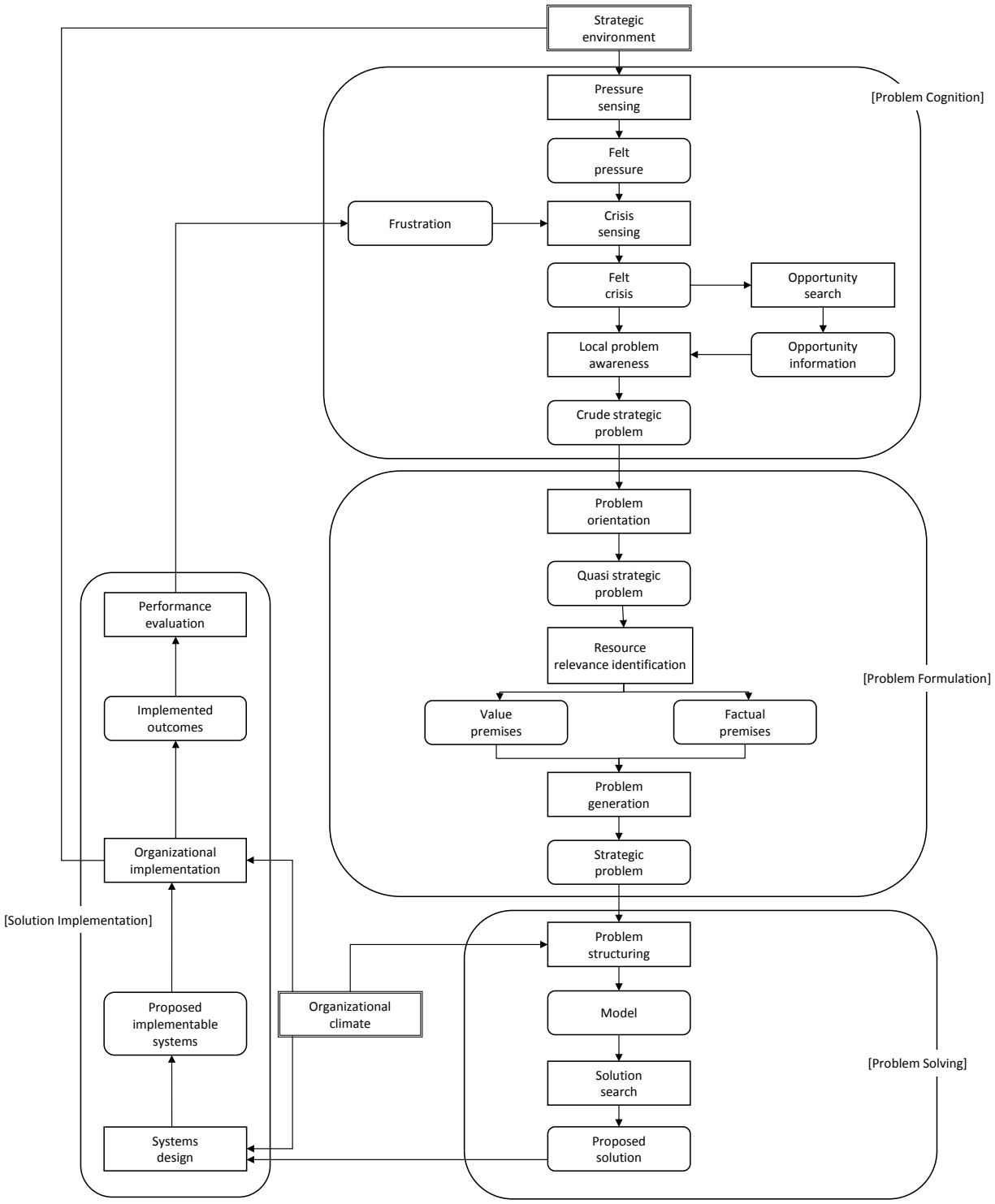

Fig.1 Cyclic Process of Strategic Problem-Handing

each elemental endogenous behavior.

(2) Technological Progress Orientation

In the face of this information era with tremendous progress of information technology, organizational intelligence might more properly be defined as the interactive-aggregative complex of human intelligence and machine intelligence in an organization.

As a matter of fact, my motivation for research in organizational intelligence has basically been stimulated by the seemingly

prevailing estrangement between human intelligence and machine intelligence as information (computer and communication) technology advances so fast in such diversified directions.

Executives and managers in organizations do not seem to be able to pertinently position and appropriately evaluate information technology, and consequently information systems, within the organization. Therefore, it would appear that we definitely need a "paradigm", so to speak, that might enable us to coordinate human intelligence and machine intelligence under one roof in the organization. I propose the concept of organizational intelligence as such a paradigm.

Particularly important at this point may be the advent and such fast development of networking technology. It would appear to be forcing us to extend the concept of organizational intelligence onto even inter- or super organizational intelligence as the information networks take on the global scale.

2.2 Basic Organizational Intelligence

The most basic components of organizational intelligence in the framework of problem-handling orientation would appear to be the following, which simply originate in the crude analogy with the individual human intelligence.

(1) Organizational Cognition

This is the capability of an organization to perceive the situation in which it functions. Namely, it is the organizational capability to identify the actuality and detect the potentiality of problems, threats, and opportunities in both

a. external environment and
b. resources availability (which might be considered the organization's internal environment) .

It is very important to comprehend that an organization would appear to have a "model", or a cognitive strategy, for filtering information coming from the external and internal environments. It might have a spectrum ranging from very vague problem consciousness to a sophisticated formal model provided by, for instance, management science.

Such a cognitive model or strategy is not necessarily fixed. Rather, it may demonstrate a very dynamic, fluid shift as the problem-handling process of the organization proceeds.

(2) Organizational Memory

This is the organization's capability to preserve and utilize the information on its experience and history. It might be classified into the following two categories; namely,

a. human memory, and
b. machine memory.

Ordinarily, organizations institute such a system as the filing system to supplement human memory. In addition, operating standards, systems and procedures, etc., could also be interpreted to be the auxiliary to human memory in the organization.

Recent advances in computer technology would seem to be making a variety of machine memory such as, for instance,

i. database
ii. knowledge base, and
iii. model base feasible.

In order to guarantee the effective utilization of machine memory, it is essential to devise the following:

① reliable "truth" maintenance (updating) system and
② efficient retrieval system.

(3) Organizational Learning

As an individual human learns from experience, we might draw analogy from it for an organization. And since there would seem to be enormous accumulation of scientific findings concerning human learning mechanism, we might find some

useful clues for studying the learning mechanism of an organization by careful examination of individual human cases.

At any rate, two types of organizational learning would appear to be observed; namely,

i. Organizational learning on the basis of its own experience.

An organization might be interpreted to be equipped with a large number of feedback circuits of its own experiences. Such circuits certainly could generate effective organizational learning.

ii. Organizational learning on the basis of other organization's experience.

This would mean a completely different learning mechanism from the above. That is, the organization must heavily rely upon the external information which it tends to make slight of, compared with the internal information.

(4) **Organizational Reasoning**

An organization, collectively, makes various kinds of reasoning for the purpose of achieving its main task; namely, organizational problem handling. Such organizational reasoning may be classified into the following types:

i. Common sense rule-following type
ii. Precedence-following type
iii. Procedure-following type
iv. Goal-oriented type
v. State-driven type (starting from the existing state of things)
vi. Dual-direction type (iv+v)
vii. Analogy type (e.g. inventory control and database updatings)
viii. Association type
ix. Conception type
x. Actuality-denial type
xi. Stirring-up type (introducing controlled chaos)

Needless to say, each reasoning type would require different kind and system of information.

2.3 Practical Organizational Intelligence

On the foundation of basic organizational intelligence as explained in 2.2 , each of the following types of practical organizational intelligence would seem to manifest itself in the actual organizations. And each type would in turn require specific type and system of information.

(1) **Operative Organizational Intelligence**

This is the intellectual capability of an organization to realize what has been determined to be done. It would require a very short-run feedback system of auditing-type information. That is, information on the discrepancy between the standard and the actuality of operation must timely be fed back to the control mechanism of the organization.

Incidentally, the Japanese organization is observed to be excellent in manifesting this type of intelligence.

(2) **Restorative Organizational Intelligence**

This is the kind of organizational intelligence which would function whenever something abnormal has occurred or is foreseen to occurr.

Two types of information would appear to be necessary and useful for such organizational intelligence: namely,

i. Auditing type

This is to indicate where the abnormality exists and, preferably, how it might be removed.

ii. Preventive type

This is to detect, in advance, any abnormal symptom and hopefully to suggest some preventive measure to it.

(3) **Preservative Organizational Intelligence**

This is essentially combination of' operative intelligence (l) and restorative intelligence (3) and is for maintaining the organization after the organizational goal has “somehow” been determined.

Naturally, its inclusion of restorative intelligence would mean that both the

auditing and the preventive types of information play a very vital role in its functioning.

The Japanese organization shows rather high level of organizational preservative intelligence due to the successful application of various management technologies such as industrial engineering (IE) , statistical quality control (SQC) , value analysis/engineering (VA/NE) , and so forth.

(4) Planning Organizational Intelligence

All (l) , (2) and (3) have to do with organizational intelligence when a goal is "given". Namely, it is the type of organizational intelligence with rather low level or autonomy.

When an organization can for itself decide upon a goal to aspire for, it is said to possess planning organizational intelligence and it is said at least to satisfy the necessary condition for an autonomous organization.

(5) Autonomic Organizational Intelligence

An organization may be said to posses autonomic organizational intelligence whenever it has combination of planning organizational intelligence (4) and preservative organizational intelligence (3) . It is then said to be endowed with higher organizational intelligence by one order than the one with only preservative organizational intelligence (3) .

As was already pointed out in (3) , the Japanese organization, even in its research and development (R&D) activities, would seem to tend to be satisfied with preservative organizational intelligence (3) . This means that it would tend to be content with a research theme or development subject that is determined outside (for instance, in the U.S. or in Europe) . And unless the Japanese organization learns to acquire autonomic organizational intelligence (5) in R&D, Japan would never deserve the name of a technologically “great” nation.

(6) Ameliorative Organizational Intelligence

This is to stimulate an organization for improvement in a certain sense. It would appear to be excited by either or both of the following two types of information: namely,

i. Unsatisfactory past performance

This is typically provided by systems audit, especially that is based upon accounting information scrupulously recording the errors of commission by the organization.

ii. Overlooked opportunity

This is not usually recorded by the conventional accounting information system. However, it would incur an opportunity cost (a missed profit which is caused by the errors of omission by the organization) .

So, such an information system that would include both types of information would seem indispensable for due functioning of ameliorative organizational intelligence.

Here too, in addition to systems audits, such management technologies as IE, SQC, VA/VE, and so on, would make useful contribution.

(7) Innovative Organizational Intelligence

This is to induce a certain quantum or discontinuous change in the organization, that is, an organizational innovation.

The clue to such innovation may be one or more of the following:

i. Foreseen threat

This may be either

a. external threat, i.e. pressure from outside, or
b. internal treat, i.e. crisis inside the organization.

ii. Foreseen opportunity

This also may be either

a. external opportunity, or
b. internal opportunity.

In any case, the cognitive capability of the organization would seem to be the key factor in organizational innovation.

The Japanese organization might be said historically to be very resilient against any external threat and somehow to survive such crisis by innovating itself. In other words, the Japanese organization would seem to demonstrate high "extrinsic" innovative organizational intelligence under strong outside pressure.

On the other hand, however, the Japanese organization would seem to have rather low “intrinsic" innovative organizational intelligence. Put in another way, there seem to be only few cases in the Japanese organization where organizational innovation really springs out of the organization inside.

(8) Creative Organizational Innovation

This is to provoke organizational creation, namely to bring about something completely novel in the organization.

Such creation may be caused by the following types of thinking.

i. Organizational dialectics

This is to reach an "elevated" state through sublation of actuality and actuality-denial.

ii. Novel conception

This is to hit upon a completely new idea for running an organization.

iii. Controlled chaos

This is to once stir up the organization by introducing a "chaos" with the hope that something novel might be generated. But since my uncontrolled chaos might end up with nothing but a confusion, some mechanism for somehow controlling the chaos must be built in the organization in order to achieve something constructive.

In any case, manifestation of creative organizational intelligence would always appear to be excited by some newly created information. Therefore, such information system that would perform "informational creation" would seem indispensable for organizational creation.

2.4 Theory and Engineering of Organizational Intelligence

Theory means the proposal for mechanism of explanation of intelligence phenomena in the organization. Engineering, on the other hand, means the proposal of policy for enhancement of organizational intelligence. The term “engineering” is used in its original sense; that is, the verb “to engineer" originally means "to dispose something cleverly". So, naturally, engineering here seeks its theoretical foundation in both natural and social sciences.

(1) Human Intelligence Aggregation

Organizational intelligence is, by definition, a collection in some sense of individual human intelligence of the organization's members. However, we do not yet seem to know about the mechanism or process of intelligence aggregation from individual human to organization, via human group.

Especially important here is the generation of group intelligence. The Japanese organization is known for its high, subtle group intelligence. The best example may be the now world-known "quality control circle". There, each member does not appear particularly impressive, but the group as a whole achieves something fantastic. We have to develop a group dynamic theory explaining this phenomenon and a design technology to further heighten such group intelligence.

When groups become larger and interconnected one another, they are formalized into an organization. In accordance with its cultural and historical tradition, the organization develops its characteristic problem handling system; for instance, the from-the-bottom-up accumulation (typically exemplified in the "ringi") system observed in the Japanese organizations and the from-the-top-down layer-by-layer translation system typically

seen in the U.S. organizations. We would seem to need some analytical tools to explain the performance of each system and some design methodologies to still enhance such organizational intelligence.

(2) **Ambiguity-Handling Intelligence**

Ambiguity is considered to be something evil in the U.S. organizations and something to be excluded. Instead, precision must be built in as much as possible whenever a system is designed, a team is organized job specification is instituted, and so forth.

However, in the Japanese organizations, ambiguity is sometimes even intentionally introduced into the organization in one or more of the following forms.

i. Structural redundancy
ii. Operational implication
iii. Iridescent decision
iv. Dual-facedness, with “in principle” and “in practice” dichotomy
v. Operative tolerance
vi. Fuzzy contract (e.g. service above and beyond contract)

In some cases such ambiguity would seem to preserve and enhance group intelligence. Typically, any group in the Japanese organization is usually very role-ambiguous; that is, each member's role and authority would be rather loosely specified. But each member has considerably high motivation and, owing to the life-long employment practice, has a fair long-term perspective. Moreover, each has “contextualistic" rather than “individualistic" disposition, and a favorable social network would appear to be very easily and quickly self-organized. So, in consequence, if any threat for group performance for instance occurs or is foreseen to occur, somebody immediately rushes to the spot and does something to recover the situation. And yet no problem of authority border transgression takes place since each one's role is ambiguous from the beginning. This would seem to be the manifestation of fairly high, subtle group intelligence with intended ambiguity.

(3) **Machine Intelligence Aggregation**

As computer and communication technologies advance, machine intelligence in an organization would seem to demonstrate the possibility of higher and higher degree of machine intelligence aggregation in an organization. Such aggregation would tend to take the following two directions; namely,

i. Network formation

Already observed is the fast development of PC-networking within and outside of the organization.

Another example is the global computer networking, whose auditing is the central theme of this conference.

ii. Hierarchy formation

The advent of powerful and yet low-priced PC's has made the hierarchical combination of such PC's with the series of computers with larger and larger capacity, all way up to the mainframe computer, feasible.

Thus, decentralization and recentralization of information systems for organizational problem-handling have been made possible.

(4) **Interaction of Human Intelligence and Machine Intelligence in the Organization**

The history of computer application in the organization would show the advancement of computer aid to human intelligence. Each stage along the line of development such as EDP-EDPS-MIS-OA has shown its characteristic human-machine interaction. In parallel with such development, the fabulous progress of computer technology has greatly contributed to the fast and diversified advancement of OR/MS, which was originally introduced into the organization as the means of enhancing human organizational intelligence.

Recent advancement in technologies for

machine intelligence aggregation as exemplified in networking and hierarchy of various kinds of computers would seem to open up another dimension of useful interaction between human intelligence and machine intelligence in the organization.

Such interaction would take place at all the levels of human intelligence aggregation; namely, individual, group, and organization. We have already seen the infiltration of DSS (decision support system) and ES (expert system) at each level.

Unfortunately, however, human intelligence in the organization would seem to be lagging a Jong way behind machine intelligence as indicated in 2.1, (1) .

All in all, I propose the concept of organizational intelligence as "the interactive-aggregative complex of human intelligence and machine intelligence in the organization". It is hoped that in this way we might be able to duly position both human intelligence and machine intelligence within the organization and discover a way of enhancing organizational intelligence with some means of effective integration of human intelligence and machine intelligence.

3. Effective Information Systems Management

3.1 Information-Value Augmentation Processes in Organization

The object of information systems management is the information-handling processes in the organization as shown in Fig. 2. It should be noticed that each stage of these processes is supposed to augment the value of information to the organization in "some" sense.

(1) Information Acquisition

This is the process of taking into the organization such information that may be provided by the organizational environment, which should be divided into

a. External environment and
b. Internal environment.

The former would mainly relate to threat (pressure) and/or opportunity which might exist or be suspected or expected to take place outside the organization in the future. On the other hand, the latter would mostly concern deficiency and/or potential in the management resources within the organization.

Information acquisition process may further be divided into the following four types; namely,

i. Environmental scanning
ii. Positive search
iii. Passive sensing
iv. Systematic collection

Essentially, information acquisition- has to do with the problem of interface between the organization and the environment.

(2) Communication

Needless to say, this is a very important process of information-value augmentation process in that

(i) it relates to all the information-value augmentation processes,
(ii) it could increase the value of information but, on the other hand, it sometimes could decrease or even annihilate the value of information, and,
(iii) in the worst cases, it could completely distort the meaning of information and thus become harmful to the organization.

Therefore, it might be said that both quality and quantity of information would be strongly affected by the characteristics of the communication process. Such characteristics would in turn be determined by

a. characteristics of the sender,
b. characteristics of the receiver, and
c. characteristics of the sender-receiver relationship, including their sentimental interaction.

Particularly important here would by the role of tacit and rather llsentimentalll communication of informal information. Many important

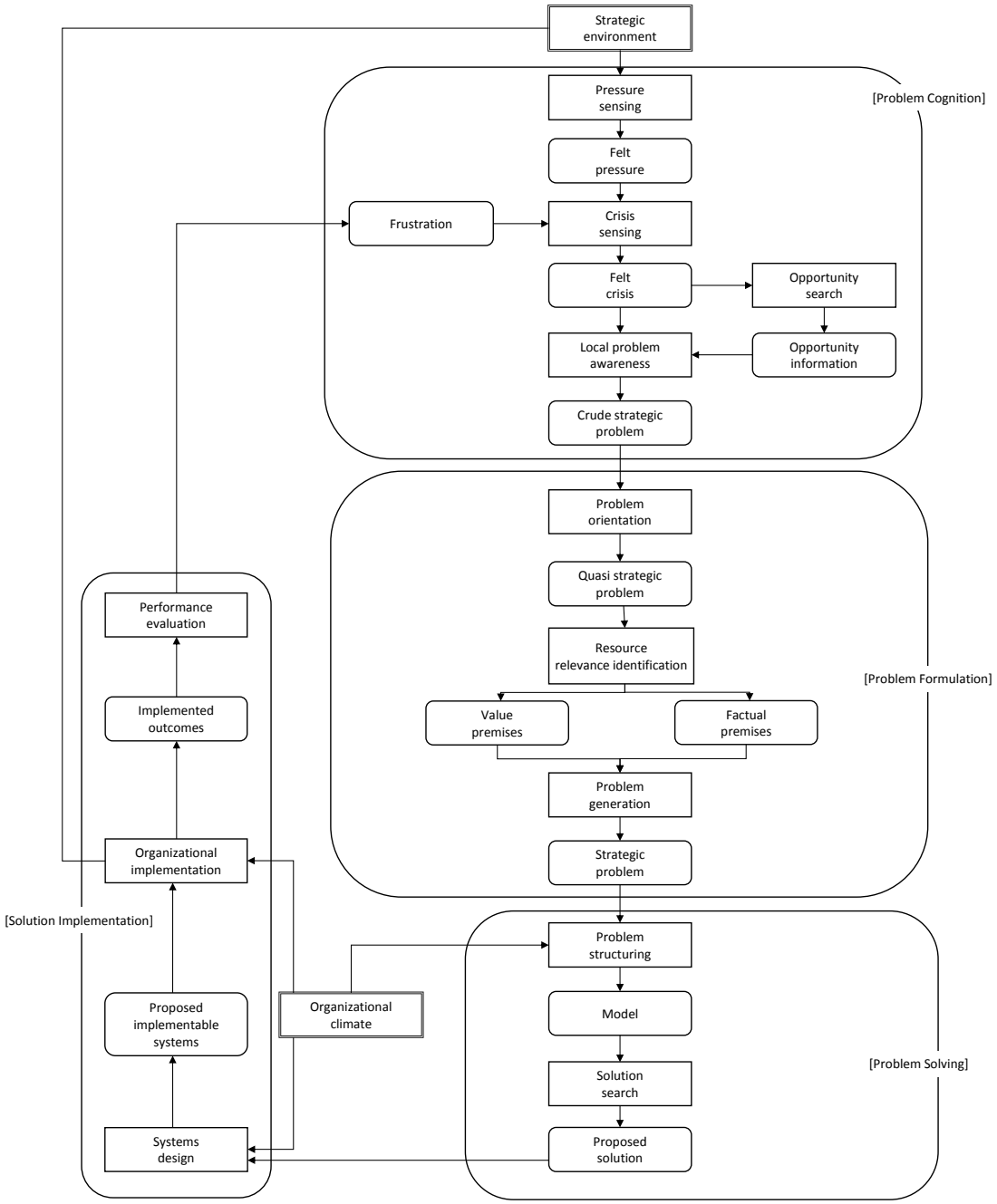

Fig.2 Stages of Information-Value Augmentation Process

matters, either vital or fatal to the organization, might be decided upon the basis of such information.

(3) **Information-Processing**

Since all the stages of information-handling processes deal with processing in some sense of information, what is dealt with in this section might be called information-processing in its narrowest sense.

Such information-processing should be classified into the following two categories.

i. Preliminary processing

This is to facilitate the subsequent stage of processing. It would include such operations as for instance;

a. Filtering (to select out the relevant information from the irrelevant)

b. Condensing (to reduce superabundant information to a manageable amount)
c. Collating (to coordinate multi-channeled, possible inconsistent, or even mutually contradictory lines of information)

ii. Structuring processing

This is the central part of the information-value augmentation making use of the high-level machine intelligence and would include such information-processing as required for

① preservative (operative+restorative) organization intelligence.
② autonomic (planning+operative) organizational intelligence,
③ ameliorative organizational intelligence, (e.g. IE or QC calculation) , and
④ innovative organizational intelligence, (e.g. OR/MS computation) .

(4) Information Distribution

This is the process of transmitting the output of information-processing to the appropriate demand points

i. within the organization and
ii. outside the organization.

Naturally, therefore, it would seem very important

a. to grasp the information demand at each demand point, and also
b. to design the distribution network of necessary information for each demand point.

The latter would derive from the design of

① the system of problem-handling activities within the organization, and
② the interface between the organization and the environment.

(5) Information Storage

This process is to increase and improve the organizational memory, and the following measures are required:

i. Information-updating

This is essentially the mechanism for truth-maintenance of information. Here, the balance between information-value deterioration as time passes and the cost of information renewal and supplement should be considered.

ii. Information-retrieval

This is the design of storing, indexing and accessing systems for quick and effective use of pertinent information. As informationalization of the society advances, importance of this process would become greater and greater.

(6) Information Utilization

This is the process of putting information for final use, and, in order to assure information-value increase, sufficient care should be taken for the following subprocesses.

i. Information Representation

This process should be very carefully designed for matching with the demand of the users. Technological progress in this area, such as computer graphic display, must be fully utilized.

ii. Informational Education

One of the wrong assumptions so frequently postulated in the design of information systems is that executives/managers know how to use information whenever it is presented to them. This simply is not true. Considerable education and learning would seem necessary for wise management utilization of information.

iii. Usage

In addition to the management education on the use of information, frequent interaction between executives/managers and the informational staff is very important. In short, rather than just showing the menu of dishes (what the current information system could do) , asking the management just to try one and getting feedback on it would seem by far more valuable in making the information system practically useful.

(7) Information Disposal

This is somewhat off the mainstream of

information-value augmentation but important as the complementary process. For, it is sometimes disadvantageous or even dangerous to insist upon wrong and outdated information. Therefore, there would seem desirable to devise some discriminatory mechanism to detect useless or harmful information within the information system.

This is a part of organizational intelligence that might be called organizational 11unlearning", which is essentially the antithesis of organizational learning. It might enable the organization to free itself from the fetters of old, fixed idea and excite its innovative organizational intelligence.

3.2 Systems Thinking for Effective Information Systems Management

At the basis of any systems management lies systems thinking. Some of its aspects especially relevant to our current discussion may be as follows.

(1) Priority-Ordering

Systems thinking may be interpreted along the following line.

i. A system may be defined as an interactive complex of multiple elements with the common objective.
ii. The objective, of course, may be multi-dimensional dimensional.
iii. There is a unique characteristic mechanism defined by the interconnection of elements.
iv. With such a characteristic mechanism as the medium, each element is uniquely connected with the overall system.
v. An impact, either exogenous or endogenous, is exerted upon a set of elements.
vi. Such an impact propagates throughout the system, generating various elemental behaviors.
vii. Totality of such elemental behaviors generates the overall system behavior.
viii. Judging from the overall system evaluation measure (s) derived from the common system objective, each element can comparatively be evaluated.
ix. Thus, priority-ordering among the elements can be achieved.

Such systemic priority-ordering would indicate where to allocate the restricted management resource (e.g. information resources) in the organization. This, in turn, would enable the organization to achieve its economy.

(2) Composite-Eyed Systems Thinking

The term “total system" is rather frequently used in connection with information systems management. Under the systems thinking, any system has two-sidedness in that on the one hand it is a subsystem of systems above it, but on the other it is a suprasystem of systems below it.

The term “total” would suggest that such system has a precise, hierarchically interconnected “order” , starting from the “total” all the way down to each element via various subsystems.

It would appear to originate from the monotheism systems thinking which prevails in the Occidental world. It is strictly founded upon the monotheism with a precise order with the God at the top.

The "total" system could be very vulnerable to any abnormality in an element or a subsystem. Such trouble would easily propagate throughout (or at least over a large part of) the system, and recovery from it may be rather difficult.

The Japanese organizations operate in the Oriental society where the polythetic or the composite-eyed systems thinking would seem to prevail. There, a number of systems, instead of one, would seem to be put into the perspective. And in contrast to the precise hierarchy of subsystems, what are observed may be juxtaposition of a set of systems which are perhaps heterogeneous and loosely-coupled with one

another.

This would seem due to wisdom in our society which realize .the limitation of our organizational intelligence that falls long way short of rightly constructing a "total" system and properly operating it.

(3) Non-Precise Systems Integration by Loosely-Coupled Networking

In the previous section, vulnerability of the too tightly coupled "total" system was pointed out. And, furthermore, prevalence of the loosely-coupled systems in the Japanese organizations was indicated.

Merits of such loosely-coupled networking may be as follows.

i. Easy designability

Separate design of each system plus loose coupling design would seem to be easier and less costly than interconnected subsystem design.

ii. Damage localization

Even if a subsystem may incur a breakdown, damage can be made limited because loose coupling keeps propagation of effects of damage local.

iii. Fast recovery

Since the damage of a breakdown is localized and the restorative operations are needed only for the broken-down subsystem, quick recovery can be expected.

All in all, loosely-coupled networking would provide non-precise, non-rigid, flexible set of systems with high resiliency (capability to recover) .

3.3 Advanced Organizational Intelligence

We may say that an organization is endowed with advanced organizational intelligence whenever it has high and reliable intellectual capability of organizational problem-handling with appropriate decision making. Requirements for such advanced organizational intelligence in relation to information systems management may be the following.

(1) Systems Orientation Revisited

Already the systems thinking basis for effective information systems management was somewhat elaborated. Therefore, only some supplementary remarks follow.

i. Systemic perspective

This is essentially the perspective from the holistic viewpoint. In other words, instead of the detail-oriented point of view which tends to pay all round attention to "all" details, the system-oriented perspective tries to pay concentrated attention to the priority point which is designated on the basis of comparative evaluation (in light of the objective) as to which detail is really important.

ii. Structural thinking

Instead of considering each element separately and independently, attention should be paid to the structural characteristics of the interconnection of elements. The system structure would essentially be determined by the identified set of causal and equilibrium (dual-directed causal) relations, and this would specify the static configuration of the system,

iii. Dynamic thinking

This is to focus attention upon the generation of the overall system behavior as the structurally-connected totality of elemental behaviors in response to exogenous and endogenous) impacts the system. Sensitivity, stability and resilience of the system would be the major concern in such dynamic thinking,

(2) Resources Orientation

It is essential to have appropriate resources on hand in order to effectively manage information systems. Of course, both quality and quantity of resources concern here.

Especially pertinent to the discussion here is the information resources which might be classified into the following categories:

i. Human resources,
ii. Financial resources,
iii. Computers and related technologies,
iv. Communication technologies, and
v. Organizational intelligence.

For effective information systems management, adequate information resources management over the following processes would seem to be indispensable.

① Procurement of information resources,
② Maintenance of information resources,
③ Improvement of information resources,
④ Allocation of information resources,
⑤ Evaluation of information resources, and
⑥ Renewal of information resources.

Of course, one of the important roles of systems audit would be to contribute to (5) especially, and all the other processes indirectly.

Particularly pertinent in this connection would seem to be the problem of security and control of computer network resources and their component facilities.

(3) Rationality in Information Resources Allocation

In the previous section, the resources-oriented aspects of effective information systems management was treated. Now, the performance oriented aspects of such activity must be dealt with.

i. Organizational intelligence premises for optimal information resources allocation

In considering the “effective” information systems management, we very frequently refer to the term "rationality". Rationality here may be tentatively defined as "the propensity to reduce the opportunity loss as long as it exists."

The extremal rationality which logically assures the state of no opportunity loss may be called optimality, and such state the optimum In other words, the optimum is the state guaranteeing that there is no more Opportunity loss or, what is the same thing, no better chance overlooked.

Optimal organizational decision-making that is so often referred to in economic theory and OR/MS, presupposes very advanced organizational intelligence or very high informational capability generated therefrom. Such premises may be summarized as follows.

① Deep insight into the range of action-alternatives
② Precise prediction as to what consequences follow each alternative-environment interaction.
③ High evaluative capability over each possibly multi-dimensional consequence,
④ High computational capability to make the best choice from among the evaluated consequences in accordance with the stipulated preference-ordering.

ii. Reality of organizational intelligence

Organizational intelligence postulated for optimal organizational decision-making would appear to be what the omniscient God has. In this sense rationality underlying such optimization might be termed omniscient rationality (Simon[5]) .

In actual situations, however, organizational intelligence would seem to fall a long way short of what such omniscient rationality asks for, mainly due to the limited organizational intelligence. And since the organization knows, or is conscious of, this fact, it would have recourse to a different type of rationality — bounded rationality.

iii. Bounded Rationality in Information Resources Allocation

Due to serious limitation in organizational intelligence, effectiveness of information systems management must heavily depend upon bounded rationality in information resources allocation.

Here is, however, a mutual amplification relationship. Namely, it would seem possible to raise the level of bounded rationality by heightening organizational intelligence. Especially pertinent here

would be some effective measures of bettering and expediting the organizational learning process.

Conversely, it could be expected that advanced organizational intelligence might be brought about by realizing effective information systems management, as the title of the present article suggests. As the degrees of effectiveness (rationality) is heightened., the more advanced organizational intelligence might be generated.

Such mutual positive amplification may bring quasi-optimality or even real optimality in information systems management.

4. New Concepts for Future Systems Auditing for Management

Some proposals might be made concerning a set of new concepts that could be useful in systems auditing in the future, especially when information for organizational innovation is in mind.

(1) Process Auditing

Instead of insisting upon auditing the outcome of working of the organization, as the conventional systems auditing does, auditing the process itself might be added or placed in the central position.

Of course, auditing all the processes would be infeasible due to the resource limitations. Therefore, proper selection of strategic points would be vital, and design procedure which would adequately balance the error of commission and the error of omission must be developed. The design of statistical sampling scheme in sampling inspection trying to establish a balance between the producer' s risk and the buyer' s risk, might provide some hint for this purpose.

(2) Experimental Thinking

An experiment, mostly carried out in the natural science areas, is used to establish a causal relationship between variables by introducing variations into one (cause) variable and observing changes in another (effect) variable.

This is essentially the same with the spirit of contingency planning, and what takes place there is a logical (in contrast to the "physical" in natural sciences) experimentation using a logical model.

Logical experimental thinking in management has recently been made feasible due to the introduction and progress of mathematical thinking and computer technology. It would enable the executives/managers to experiment with various ideas of theirs, starting from the auditing information, to see what they might bring up to the organization.

In this way, they might be able to artificially cultivate their feeling of, and insight into, their own jobs. In the past, this was done using their own organization as an experimental laboratory, under the risky conditions where a failure could be fatal to the organization.

(3) Opportunity Loss

This concept was already introduced earlier. It is essentially a loss incurred by overlooking an opportunity or by not doing what should be done.

In whatever we do, we carry with us the possibility of two types of error; namely,

i. Error of commission - doing what should be not be done, and
ii. Error of omission - not doing what should be done.

In a baseball game, the former is something like swinging at a ball and missing for a strike called, and the latter is overlooking a strike ball.

In the usual accounting and financial information system, an error of commission is very strictly recorded in the form of an actual cost, whereas an error of omission which is in the form of an opportunity cost is not recorded. Consequently, the former becomes the object of conventional

auditing, whereas the latter slips out.

Opportunity loss or cost would indicate where a breakthrough for organizational innovation might exist. Therefore it is a very useful and important trigger for the innovative organizational intelligence.

Specification and measurement of an opportunity loss or cost, however, may not be easy, because it is defined strictly in connection with a particular "system". So, a very clearcut system specification is preprequisite.

At any rate, future systems auditing must deal with the concept of opportunity loss or opportunity cost, if it is to somehow contribute to organizational innovation and still further to management in general of the future organizations.

(4) **Disposition for Optimization**

In view of the very limited organizational intelligence in reality, most of the decisions in actual organizations, and in actual lives for that matter, would seem to be made on the basis of the satisfying criterion; that is, human motivation for making a good decision is high until a certain "satisfactory" aspiration level (a goal) is achieved (or foreseen to be achieved), but such motivation is lost as soon as the prospect of goal attainment is seen. This is perhaps the reality of organizational decision- making.

Disposition for optimization, namely attaining optimality, would ask for further effort beyond the attainment of the for-the-time-being satisfactory goal. Here, the concept of opportunity loss comes in. That is, disposition for optimization always assumes the existence of opportunity loss; in other words, it is always unsatisfied, until the optimality is achieved.

In reality, however, organizational intelligence is not so high. Therefore, it is difficult to carry out real optimization. But as was stated earlier we might be able to advance organizational intelligence by improving and expediting organizational learning and thus enhance organizational adaptation of the organization. Thus, we might reach the state of "quasi-optimation" Of course, if the situation permits, we can apply the OR/MS methodology to organizational problem-handling. And we may be able to inlay a number of optimalities here and there in a system, for the totality of which we may be satisfied with the quasi-optimality.

(5) **Post-Optimality Analyses**

If we are lucky enough, we may be able to employ a certain powerful OR/MS technique such as linear programming (LP). And if we are further lucky, we may have an organizationally viable model which has obtained a reputation to be reliable and useful. In such a fortunate case, we can carry out a number of interesting experiments.

i. Sensitivity analysis

We may try a set of "if-then" type questioning by introducing all sorts of variations into the model and observe what happens to various points in the model.

ii. Opportunity auditing.

For instance, let us suppose that an oil refinery product-mix planning has been successfully incorporated ted into a linear-programming model, and that the optimal production plan has been calculated toward the objective of profit-maximization.

The usual auditing procedure would compare the actual performance at the end of the period, say a month, against the plan, which may be termed the ex ante optimum (Fig.3). The difference, however, would seem to contain two errors mixed; namely,

① Error in predicting the demand, committed by the planning division, and

② Error caused by inappropriate measures in operation, committed by the refinery.

Thus, the divide of responsibility

between the planning function and the operating function is not clear, and consequently, familiar mutual blaming.

Now, we propose the new concept of the ex post optimum (Fig.4) . It is calculated by substituting into the LP model in the actual (observed) values instead of the predicted values used in the ex ante optimization. It would mean that, even though the environment was more severe than predicted, this much could have been achieved if the refinery had functioned properly. That is, the difference that was provided by the conventional auditing could be divided into two; namely,

a. Difference between the ex ante optimum and the ex post optimum: responsibility (due to prediction error) of the planning function, and

b. Difference between the actual performance and the ex post optimum: responsibility (due to operation miss) of the operating function.

In a word, the ex post optimum would provide the divide of responsibility between the planning function and the operating function.

iii. Repercussion Study

Even though the optimality derived from an OR/MS model is the most desirable for the system which the model represents, when the result is introduced

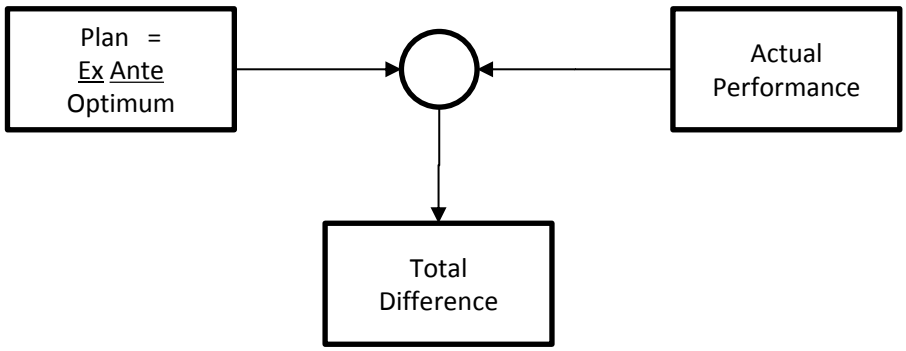

Fig.3 Conventional Auditing Scheme

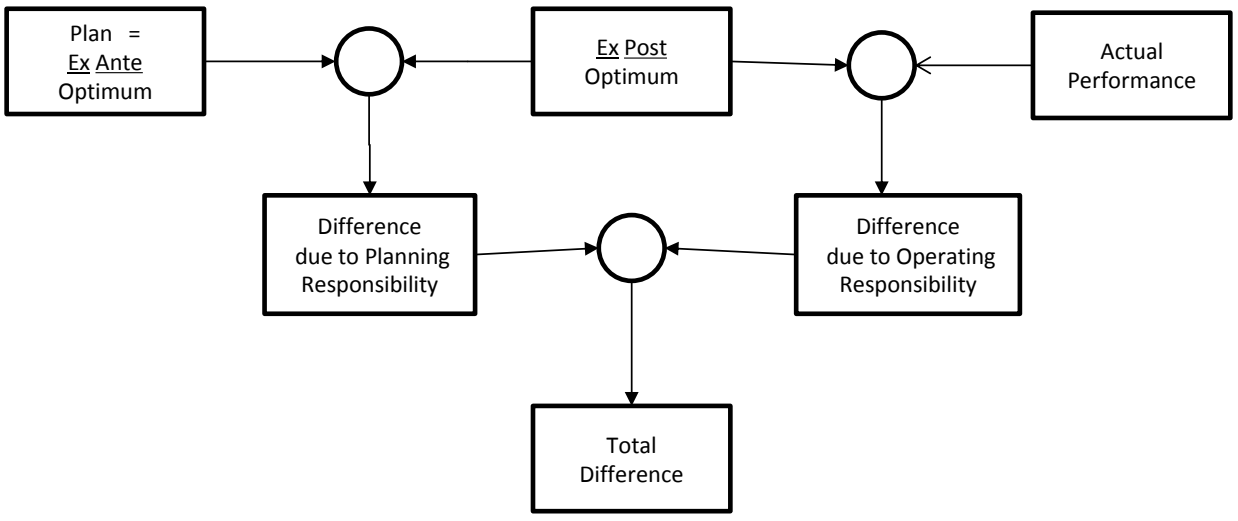

Fig.4 Auditing Scheme Using Ex Post Optimum

in the organization, something undesirable might happen somewhere in the organization. In this kind of case, very careful post optimality analysis must be made by tracing through the repercussion effects within the organization in response to the impact of introducing the model result. And due judgement must be made as to whether introduction of such a locally optimal system is, from the viewpoint of the overall system, really advantageous or not.

This caution should be taken in any case of introducing a new system into the organization as the outcome of systems auditing.

Concluding Remarks

Orientation of systems auditing in the present paper has been that of "for management of organization" throughout. In consequence, technicalities of the subject have largely been slighted.

It is firmly believed that the concept of organizational intelligence is of great use both in organization theory and in management practice. It is proposed to rewrite organization theory, so to speak, which may be interpreted as the theory and policy of intelligence aggregation of human and machine. It is also proposed to enable executives/managers to comprehend the functions of human and machine and so to duly position and evaluate information systems in their proper and useful relationship with human employees in the organization.

Systems auditing in this era of global networking should be able to specify and measure such kind of opportunity loss or cost that may incur in the cases of breakdown, for instance, so that the criteria for responsibility sharing and the breakthrough points for future development and improvement may be clarified.

It is essential to point out in this way where organizational innovation may be possible for the future leap of the organization. Indeed, it is the royal road of enhancing organizational, and furthermore, interorganizational and supra· organizational intelligence.

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