The impact of technology on the future state of information technology enterprise

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PREPARING FOR TOMORROW

In the near future the cumulative impact of consumer demands for certain goods and services, eminently absent from current information system inventories, will surface in the competitive market place. At that time many information technology enterprises (see Table I) that are not now prepared to meet the demands will be forced (or, maybe, freely enticed) to alter their courses of action, to hurriedly seek new endeavors and invest heavily in more diverse resources and capabilities. And such extraordinary measures that augment archaic practices, will be employed in order to maintain a survival posture. However, it is not necessary for the subject enterprises to wait for the consumer's broadcast before embarking on ad hoc augmentation adventures.

The intent here is to outline a few principal techniques and programs that can answer cogent questions about preparations for change and survival. As an introductory offer, several outstanding preparatory measures which the subject enterprises should, or will be seriously engaged with in the next 5 to 10 years are listed in Table II. It is almost certain, for the most part, that no radical or revolutionary transformations need occur within a specific enterprise, or even within the industry, especially if the initiation of preparatory programs anticipate or at least attempt to parallel consumer demands. The technological pursuits (Items 1, 2 and 3 in Table II) represent aggregates of expected consumer and market demands that also signal evolutionary trends or technological requirements. These, in turn, will require adequate and timely reactions by the information technology industry, which can only be effected by the initiation of the noted preparatory programs. Before further elaborations on the techniques to derive essential preparatory programs it would be helpful to first put them in perspective.

TIMELY POLICIES

Product or mission oriented

Frankly, acquiring and building the kinds of goods and services that can accommodate the impact of evolutionary trends will require no complex or innovative formula. Only a shift in enterprise policy and procedural emphasis is necessary, but a shift that is nonetheless significant because it entails the reallocation of resources and expenditures applied to the production of goods and services. The alternative is to stand still and continue the current operating pattern. Still, as the evolutionary signs grow stronger the subject enterprises will have to make a commitment deciding whether or not to remain with a policy of product performance maximization (PROMAX), which has of course been very profitable so far, or to introduce a policy feature that will divert some crucial energies to accomplish what can be labelled as mission performance maximization (MISMAX). And it is within the rationale of this latter policy that we shall also find the key thrust of the evolutionary trend.

Retarded robots

The MISMAX policy stems from justifiable and somewhat negative consumer attitudes toward information systems as a viable and effective commodity. MISMAX specifically represents unwritten yet unavoidable invitations to fix known technological gaps or lags, weaknesses and faults that hinder maximum application of available system products. Behind these invitations are reasonable people who, while they continue to adopt consecutive product increments, are nevertheless also becoming discontented about the costly imbalances now existing among supposedly complementary system components. Or stated more concisely, these claims are indicative of two prevailing conditions: (1) there are a few major system components (hardware or software or humanware) that seem too advanced for full utilization, i.e., they cannot be used at or near capacity, because complementary components are either inadequate or non-existent;

Table 1 (derived from reference 9) presents a list of pertinent types of enterprises. The general category of enterprises includes profit and non-profit organizations engaged in hardware, software, systems engineering, R&D and allied services associated with the development/uses of information processing systems.
Table I—Major Enterprises Information Technology

<table>
<thead>
<tr>
<th>Equipment and Related Support</th>
<th>Computer Services</th>
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<tbody>
<tr>
<td>Mainframe (CPU) Manufacturers</td>
<td>Regular Service Bureaus</td>
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<tr>
<td>Peripheral Manufacturers</td>
<td>Time Sharing</td>
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<tr>
<td>Mini-Computer Manufacturers</td>
<td>Network Management Libraries</td>
</tr>
<tr>
<td>Electronic Components</td>
<td>Other Services</td>
</tr>
<tr>
<td>Information/Computer Technology Research</td>
<td>Facility Management Systems Management</td>
</tr>
<tr>
<td>Other Automated Processing Equipment Producers (OCR, COM, Process Control)</td>
<td>Education, Training and Information Media Suppliers</td>
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Table II—Primary Technology Enterprise Preparatory Program Elements

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<thead>
<tr>
<th>TECHNOLOGY MARKET ELEMENTS</th>
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<tbody>
<tr>
<td>1. To develop internal capabilities in computer science, engineering, and market analysis</td>
<td>Prepare resources to implement special software, hardware, and system engineering organizations, in support of corporate program management.</td>
</tr>
<tr>
<td>2. To develop specialized internal support organizations</td>
<td>Prepare resources to implement special software, hardware, and system engineering organizations, in support of corporate program management.</td>
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<tr>
<td>3. To develop specialized external support organizations</td>
<td>Prepare resources to implement special software, hardware, and system engineering organizations, in support of corporate program management.</td>
</tr>
<tr>
<td>4. To develop an external market forecast</td>
<td>Prepare resources to implement special software, hardware, and system engineering organizations, in support of corporate program management.</td>
</tr>
<tr>
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Shifting commitments

If critical deficiencies persist and expand the hope of achieving significant technological objectives—as mass information system network-utilities, or the intelligent man-machine system, among others noted later on—will remain as idle dreams for some time to come. Furthermore, if the consumer is not able to fully use what he has already, can information technology expect to continue selling product improvements or refinements that could compound the consumer’s problem? This market approach, by the way, is representative of a PROMAX policy. Standard PROMAX practices are directed in the main toward iterative redevelopment or improvements of a current product line or technique (by improving or increasing a product’s capacity and/or by reducing production costs). Yet, at some point in time a PROMAX program becomes problematically anachronistic and risky, especially a program that is not supported through supplemental programs such as new product/technique R&D. Now, these program conditions will not impress the consumer as much as they will the technological enterprise. When faced with disconcerting conditions the enterprise will not easily be able to reallocate limited energies, resources and expenditures to cover both current product improvement activities and the development of new and perhaps replacement items being sought by the customer.

SURVIVAL

Free market factors

The problem of making a timely commitment to more fruitful policies and programs is of course not always so easily resolved. Many technological enterprises cannot afford to engage in both a strict PROMAX policy and supplemental R&D programs that anticipate future market place demands. And in a free market environment how then can we induce prospective victims of evolutionary changes to shift their soon-to-be “fatal” policies? The normal route usually consists of impatiently waiting the sudden felt signals of supply and demand pressures. But by the time the manifest pressures are felt and understood, by some PROMAX oriented firms it is too late to enable a quick and healthy recovery. So this problematic condition leaves us with a question as to how the subject enterprises can be aided in recognizing and accepting (near-future) technological trends, to assist in the timely reduction of all too risky PROMAX ventures and re-orientation toward MISMAX programs.

Internal factors

Essentially, survival in a free market environment will depend for the most part on how well an enterprise allocates, adjusts or commits its internal factors (resources, goods, services, investments) to accommodate anticipated or forecasted market demands, in the MISMAX sense. In order to identify and regulate internal factors—the degree of preparatory program elements implemented—the enterprise should also engage in systematic technology forecasting and planning programs that serve twin purposes. First, the forecasting program can structure a wholistic picture of relevant external factors that will impinge on the future state of an enterprise’s intrinsic factors. Table III presents a succinct list of those factors. Second, the forecasting program can aid in generating plans for preparatory programs, continually structuring the means-end activities required for some period into the future.
A profitable and cost-effective preparatory program can only be gained when adequate resource expenditures are made available to purchase the necessary baseline forecasting capability. Initial efforts of significant magnitude will therefore be required to create a detailed mapping of each inevitable extrinsic and intrinsic factor. The mapping tasks entail the identification and allocation of sufficient qualitative and quantitative attributes—time scales, probabilities, weighted events and priorities, dollar amounts, utilities, authentications, goals, life spans, among others—associated with each factor, for the essential purpose of generating an indispensible, real-time, forecasting data base. The price of building and maintaining this data base will be returned dollars for pennies, for with this rich vein of information we acquire a better understanding of the events impacting our livelihood and can better control our own forces to maintain a posture of survival.

The first areas to be mapped should be the extrinsic factors depicting technological capabilities, trends and presumed information technology requirements, as outlined in Table IV. Not only is it important to identify each topical subject of concern, but it is equally as important to apply appropriate qualitative and quantitative attributes, the sources of which are noted shortly. These attributes will eventually be applied as criterial elements within the context of a continual comparative analysis that is intended to assess the internal status of a subject enterprise’s factors in terms of extrinsic market conditions, trends and demands. The main features of these criterial attributes can be easily discerned by seeking complete answers to certain questions, using Table IV entries as topical guides. Procedurally, after deriving relevant “requirements imposed on information technology,” one would evaluate the current position and capabilities of information technology and determine: what is and what is not being accomplished, what must be accomplished, when and how, to satisfy the aims of technology. This initial set of steps should then be followed by a determination of: what competitors (and consumers, and funding sources) can and cannot do, what is being done and planned and what they say has to be done. Subsequent to these studies, an enterprise must, of course, map the current state of its own set of intrinsic factors, as an extension of the Table III (Columns 5, 6 and 7) entries.

**Valid sources and good indicators**

Now, with our abundant supply of information media and channels it should not be too difficult to find proper sources containing the answers. However, the issue of source message validity and reliability or meaning will certainly have to be tackled, given the often intangible and moot nature of the subject matter. Or stated in more practical terms: How does one cull a source message for reliable and meaningful intelligence? And how can one select valid operational indicators that signify, to varying degrees of certitude, the extant state of extrinsic trends that might have potential impact? Providing methods to resolve these problematic issues, unfortunately, is not within the purview of this brief essay. There are, indeed, many ways to identify and measure meaningful information within the context of well structured intelligence data analysis. But I wouldn’t really be skirting the problem by stating that knowledge and application of such techniques are an integral part of a technological forecaster’s span of abilities. In this particular case for example, a forecaster would stipulate whether or not singular overt...
expression, by several consumers, of either general dissatisfac­
tion with a product or desire for a new product would constitute a reliable and cogent attribute—or an industry consensus—depending on the weighted levels of confidence, certitude or authority assigned (by a forecaster), and supported perhaps by confirmations of past judgments by these spokesmen. However, for the simple purposes of this essay, it is probably more important to disclose some of the intelligence sources, and indicate the purposes they could serve. Table V presents such a disclosure. Here again, unfortunately, the captured intelligence data will be frequently superficial in depth, thereby requiring further probes and investigations to gather a necessary level of detail for the forecast data base.

Analyses

A primary goal of forecast analysis is to reduce, to workable and understandable dimensions, the complexities of present market place conditions in terms of the directions and pathways dictated by selected future states. The forecast approach is intended to expose cogent economic and technological potentials and their contemporary constraints, as well as provide the rationale for crucial preparatory programs designed to equalize threats (competition, enemy technology, disequilibrium) and gain a prosperous market posture. Procedurally, a forecast analysis, which can be performed in several ways to serve many purposes (see References 1, 3, 7 and 11), interprets present conditions and potential in terms of two gross interrogative objectives, viz. (a) what can we possibly achieve in the future with what we now have (an exploratory forecast); and/or, (b) what must we do now in order to achieve a future goal (a normative forecast)?

Yet, while the results of a forecast analysis might well provide a concise picture, so to speak, of things to come and things to do the picture will not be complete. An enterprise still needs to know how, why, when and with what, before it can make a commitment decision. A more complete set of answers to the latter group of interrogative objectives can be developed through the application of two techniques which are complementary to the forecast function, viz., technological planning and assessment. The utility of these two additive functions can be defined, briefly, in context, as follows. Planning, of course, refers to a method that generates discretely bound and ordered arrangements or sequences of actions (preparatory programs) meant to achieve a specified goal or target. Technological assessment—a feedforward or ada-predictive operation—refers to a method that analyzes a series of preparatory program(s) and ascertains the anticipated benefits and risks of each program alternative in terms of extrinsic factor impact, exploring and exposing the probable consequences and potential of each program.

Synthesis

Although the orientation of this essay leans toward the implementation of a morphological forecast analysis, the attributes of the forecasting data base described earlier can also be applied for assessment and planning purposes (and to other forecast analyses as well, such as microeconomic, heuristic and intuitive techniques). The approach to the joint application of forecast-planning-assessment functions is relatively simple, straightforward and iterative. In essence, the following controlled path should be programmed:

1. Data Base Generation
2. Forecasting
3. Planning
4. Assessment
5. Commitment/Decision and Action
6. Program Monitoring and Feedback
7. Adjustments/Additions to Functions 1–5

To complete this discourse on technique a short description of elementary operational requirements associated with the forecasting, planning and assessment functions is presented in Table VI. Because of the potential complexity involved in accessing, manipulating and relating the range of data base attributes, among other (mental) information processing tasks, it is suggested that these requirements be translated into (EDP) computer software functions, to take advantage of automated information processing capabilities. (Although this latter bit of advice might seem obvious, it is nonetheless offered because quite a few information technology enterprises will not
Surprisingly, our hypothetical umbrella is unobstructive to the subtle signals of imminent decline or events signaling possible repudiation. In this final chapter, certain negative (inner) and positive (outer) confirming signs of probable decline are presented. Their disclosure is intended to spark subject enterprise vigilance and direct attention to signs of the times before the consequential impact of change is felt.

To briefly illustrate the consequential results of inappropriate reactions to signs of change, let us go back in time and review a particular telling event: In the mid-1930's American railroad industry executives produced and narrated a documentary film intended to promote public interest in transcontinental passenger travel. As a bonus offer, or what we might today call a sales gimmick or loss leader, the film's railroad executive-narrator suggested (not too seriously) the possibility of interlinking transcontinental railroad travel with short airplane trips, at the passenger's option. Passengers could leave the train at one city where they would board an airplane to transport them to another city en route, at which point they would reboard the train, and so on through to the coast. In a concluding footnote to the film, in reply to the statement that this proposed joint travel arrangement could very well be destined to be the future of transcontinental passenger travel, a nodding consensus was expressed by the chorus of railroad executives present—as an indirect boost for a young airline entrepreneur sitting amongst them (it was either Rickenbacker or Lindbergh).

An epilogue to this situation occurred in the mid-1960's, when the film was shown again on national television as part of a series of comedy films. The film elicited a comic effect because the audience pictured Molierian executives slipping on many banana skins in the intervening three decades. Even when subsequent events indicated signs of change, these executive decision-makers continued to manifest idee fixe attitudes that overvalued the service's current potential and consequences.

Signs of decline or death

Creating a believable causal link between extrinsic and intrinsic signs of change is often difficult because of a time differential that exists between the occurrence of the two. Extrinsic signs, which normally occur well in advance of intrinsic signs, will not normally have any significant effect on the intrinsic signs' initial latency period. (See Figure I, area between t₀ and t₁, for a schematic illustration of this process.) And any enterprise that is a party to this hazy condition faces a problem, for they will indeed have difficulty measuring and confirming the strength and potency of the several diverse signs identified as being precursors of change, since intrinsic reactions will not as yet have occurred—as negative confirming evidence. Given an adequate multi-variate forecasting capability any positive interpretation of the instrumental nature of extrinsic factors could provide sufficient lead time to at least prepare a search for other possibly related clues, attesting further to the probability of change. However, as described earlier, the policy of

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<td><strong>FUNCTION</strong></td>
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<tr>
<td>TRENDS</td>
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<tr>
<td>FORECAST I: Match Posture</td>
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<tr>
<td>FORECAST II: Planned Postures</td>
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<tr>
<td>PLANNING: Preparatory Programs</td>
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<td>ASSESSMENT I: Venture Plan Parameters</td>
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<td>ASSESSMENT II: Venture Plan Outcome</td>
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many enterprises in a free market is to await the felt pressures of supply and demand. Which is to say that they will await for more direct, certain and tangible signs, viz., uncontrolled impacts on intrinsic factors. But at that point in time extrinsic changes would be well under way, and (as noted in Figure 1, area beyond t₁) the subject enterprise’s adaptation-recovery programs would be costlier and riskier.

The following is a listing of selected extrinsic and intrinsic indicators which, this author believes, will serve as the most significant signs of change. (The term significant, here, is, of course, used in a relative sense, its definition being a function of an enterprise’s own stated condition, including the possible fact that the enterprise may itself be a major initiator of forecasted technological changes.)

Extrinsic:

• Resources—evidence of continual searches and acquisitions (by industries not listed in Table 1) of professional level personnel representing changes in required educational backgrounds, and/or representing the initiation of new endeavors (competitive)
• Consumer—evidence of continual changes in source of (contracted) services, and resources; in sources and types of information system goods and services acquired and developed
• Competitors—evidence of notable shifts by major competitors in types of resources acquired, released; types of contract services; facilities gained; enterprises acquired; and types of standard goods and services sold, or dropped from inventory
• Funding Sources—evidence of notable increases and decreases in planned and available dollars; allocations of dollars for specific goods, services and resources; shifts in types of winning contractors

Intrinsic:

• Resources—increasing loss (within specified period of time) of principal managers and professional personnel; reduced saleability of current professional capabilities; partial or total lack of resources to enable successful competition for major funding source contracts
• Goods/Services—reduced saleability of current line of goods, services and techniques; partial or total lack of goods, services, techniques to enable successful competition for major funding source contracts; decrease in number of consumer-based contracts and/or decrease in size of contract. (The ultimate test for significance in, for example, reduced sales, would be the occurrence of lost income, profits and higher operating costs.)
• Capital Expenditures—increase in expenditures to maintain market positions, especially those associated with increase in number of competitors for contracts in some goods and services category and/or reduction in contracts won (or RFPs received) in other categories. (The ultimate tests for significance in, for example, expenditure increase, would be the occurrence of extended, below-the-line profit/loss ratios and cash positions.)

Three strategies

This concluding section focuses on three general strategies, the execution of which depends on an enterprise’s current posture and prevailing policies. To select an appropriate approach an enterprise would, in terms of its technological forecasting ability, review its current posture to identify strengths and availability of goods, services, resources, capital, income and market potential. In sum, the principal features of the three strategies include:

1. Immediate—to implement actions prior to initiation of trend (or to initiate trend) to act as prescriptive agent. This approach will require risk expenditures the extent of which will be a function of basic capabilities available and required, and the expected market payoff. This strategy would be initiated during the time period shown in Figure 1 as t₁ to t₂, and would rely mainly on the current scope of resources, goods, services and income during this period. Since this strategy entails the greatest gamble, significant changes to these intrinsic factors will probably occur in the post-t₂ period. The successful execution of this strategy, to its fullest, would also require the following types of posture-sustaining actions:
   a. investments in marketing efforts to sell anticipated new products
   b. investigating other marketable areas and capabilities (for periods beyond t₂ and t₃) plus inclusion of technology forecast engineering programs
   c. investments in enterprise promotional activities
   d. investments in management development programs and professional promotional activities (publications, professional societies)
CONCLUSION

Since most readers have little interest in perusing didactic conclusions this one will be short.

The underlying theme of this essay was to propose a viable class of attitudes, goals and elemental control techniques that could be applied to stabilize the two opposing forces affecting organizational processing—adaptation and extinction—as they are implied in the life and death cycle of a substantive (information) technology-bound enterprise. To be sure, such enterprises, as organismic parts of an institutional body, are not immune to the debilitating effects of budding evolutionary predicates of technological change. Because of the potential hazards in times of rapid external changes, the signs of the predicates must not be quickly interpreted as mere circumstantial evidence, although some may not yet be substantiated. However, the veracity of the signs will certainly be verified by tests of reality, over time, especially as we listen to the final calls by early victims. As a concluding proposition, the following is offered: that the enterprises of information technology must avail themselves of any useful and effective technology that can purchase and sustain a posture of survival.

REFERENCES

8. Data Base Management System Requirements, Joint Guide-Share Data Base Requirements Group, November 1970 (Chairman: W. D. Stevens, Skelly Oil Co., Tulsa, Oklahoma).