Chapter IV

Application Layer[1]

STRATEGY AND RATIONALE

The goals of the Application Layer of the Enterprise Information Infrastructure are:

1. To empower the organization (via enterprise computing-EC) in optimizing the use of resources, such as manpower, money, material, machines, management, and the marketplace in business,

2. To empower individuals (via end-user computing-EUC and enterprise computing (EC) - Figure 4-22) in gaining cognition about managed resources and processes in the business environment.

The strategy of implementing these goals is based on the growing expansion of the applications' integration across all business functions in the networked and Web-driven environment.

The integration of business applications in an enterprise is the natural process that follows the pattern of reproduction processes in nature. The first stage in these processes is the growth by division of functional organs; and the next stage is the consolidation of these organs into a non-redundant wholeness. In such a way the evolution of nature takes place with feedback from the environment.

The applications' integration follows the premises of the General System Theory, defined (in the 1930's and 1940's) by a German-American biologist, Ludwig von Bertalanffy (1968), who argued that artificial systems, to be fully effective, should copy the construction of biological systems, the most perfect in our world. The contribution to that theory was provided by Norbert Wiener (1948) who defined cybernetics as knowledge about communicating in animals and machines through feedback. For almost the second half of the 20th century these theories were applied only as "the approach" and in a limited manner, since the tools of their applications were just in a conceptual or developmental stage.

The rapid development of computer networks, the Internet, and the Web technology have made it possible to apply in practice these theories in the integration of business application in such a way that the enterprise becomes more coherent, more "organic," less redundant in subsystems, more communicative, and responsive to business challenges.

At the same time, the "feedback" from this type of development raises awareness and skills among business executives and professionals who pursue with rapid decisions the transformation of information islands into an information continent. Those who lead this transformation in the 21st century will become the richest people in the world, as took place with the initial leaders of the Industrial Wave at the end of 19th century. One can say after 100+ years that history has repeated itself and now the new Information Wave is absorbing the best minds of developers and entrepreneurs, just as was the case in the Industrial Wave.

SEMANTIC LADDER – ARITHMETICS OF INFORMATION PROCESSING

To understand computer applications in organizations one must understand the concept of information, which determines the scope and limits of those applications.

It is evident that the dynamics of the universe are determined by the cognitive relationships that govern the purposeful development of the natural and artificial systems. These relationships convey units of cognition whose substance is "mental" and create a "mind event." In man's environment, his state of mind (cognition) steers the environment. In an animal's environment, the state of mind (instincts and natural laws) controls its environment. In the

world of the inanimate object, particularly in the scope of machines, their internal logic is steered by scientific ideas applied by the designers.

Cognitive relationships operate through the pragmatic process of communication, which conveys meaning via transactions, data, information, concepts, knowledge, and wisdom.

A *transaction* is an activity that reflects the nature of the organization. An example: manufacturing companies are based on activities that transform labor, materials, and money into finished goods; accordingly, transactions in these companies describe sales, receipts, expenditures, changes in personnel, and changes in inventory levels.

A *datum* is a measuring unit of cognition that describes transactions between natural, artificial, or semantic systems. In the business system, data measures the performance of production, distribution, transportation, or service. For example, *Time* magazine sold one million copies in 1985. Thermometer readings describe the temperature of the air. In September of 1986, there were 255 male and 187 female registered members of the Dynamic Health Club in Portage, Michigan. The rate of return on short-term bond funds in the 401 K plan has risen 6.8% for the last quarter.

Information is a comparative unit of cognition that defines a change between the previous and the present state of the natural, artificial, or semiotic systems. The business system, for example, can provide a consensus that a given business is in a normal state, a conflict state, or a crisis state. Through the comparison of actual data from two different periods of business operations, the difference between which is compared to standards for analyzed performance areas, one can draw a conclusion about the change in business. Continuing with the previous examples, *Time* magazine was the best selling magazine in 1985. The difference between two thermometer readings taken at different times indicates changes in air temperature. In September of 1987, membership of males dropped by 15% at the Dynamic Health Club in Portage, Michigan, while female membership increased by 30%. The rate of return on short-term bond funds in the 401 K plan rose 1.5% since the last quarter.

A *concept* is a perceptive unit of cognition, which generates thoughts or ideas that create our intuition and intention, a sense of direction. Applying this to the previous examples, more *Time* magazines should be printed and made available in Europe. The phrase "it is too hot" indicates the perception that the air is not comfortable. Women are becoming increasingly more health and weight-conscious while men are losing interest in health and fitness. As a participant in the 401 K plan, I should increase my contribution in short-term bond funds.

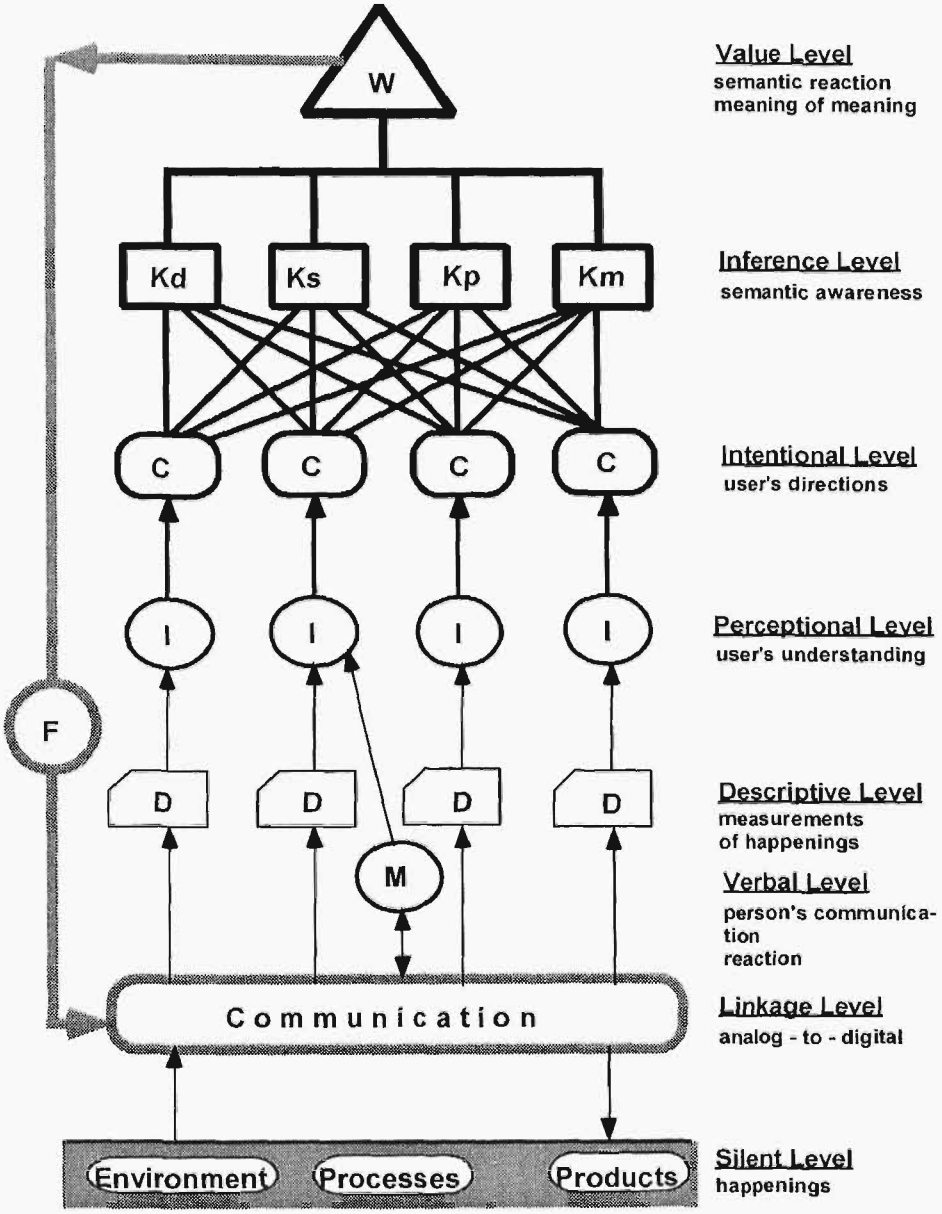
Knowledge is a reasoning unit of cognition that creates awareness based on facts, rules, coherent inferences, and well-defined methods. This knowledge provides a point of reference; a standard for our way of analyzing data, information, and concepts. The following types of knowledge are recognized: personal knowledge (kp), domain knowledge (kd), societal knowledge (ks), and moral knowledge (km). Once again elaborating on the previous situations, an increasing demand for a product necessitates an increase in the supply of the product; therefore, a wider distribution of *Time* magazine is needed. "Hot weather can be dangerous" is a conclusion based on past experience. Surveys on fitness show that men are more interested in body building and that women tend to enjoy aerobics and cardiovascular exercise. The rate of return on short-term bond funds will continue to be high if interest rates remain high.

Wisdom is a pragmatic unit of cognition which generates volition, a chosen way of acting and communicating. It is a process of choosing ordered routines which provide success and eliminate obstacles in performance. Concluding with our examples, *Time* could be printed in Mexico, where there are lower labor costs. To increase the number of men joining and staying with Dynamic, the club will invest in more body building equipment such as weight lifting apparatus and Nautilus machines. "Do not allow the patients to exert themselves in this heat." Economists predict that interest rates will begin to fall in the near future; therefore, I will decrease my contribution to short-term bond funds and channel the majority of my contributions into another option in the 401 K plan that is less susceptible to change in interest rates.

A hierarchy of cognitive units creates the semantic ladder, which identifies the process of cognition from the simplest to the most complex units. The semantic ladder is shown in Figure 4-1.

At the silent level, happenings within the environment, objects, and processes are described as data (D) and inserted into the linkage of the human communication system. This data is subsequently processed into information (I) and concepts (C). At the verbal level, we find the men (M) who create information, which contains the user's intentions (communication reaction). Once data has been processed and human information has been provided, they create the intentional level of cognition where the user assigns significance to the silent and verbal levels of happenings. As a result, other alternatives of information and new concepts are created. From the information and concepts emerge the semantic structures under the form of the previously discussed types of knowledge (K). At this level of cognition, reasoning takes place. Wisdom (W) is applied at the value level, where reasoning is utilized with the aim of deciding between the various available courses of action. Cognitive wisdom is

Figure 4-1: Semantic Ladder (Targowski Model)



a pragmatic apparatus which formulates a communication frame (F) composed of a message and reflecting information (intentions). That frame enters the cognitive communication system and interacts at the verbal and silent levels with the natural and artificial systems. The frame closes the loop of the cognition process, causing two events. The first is a semantic and communication reaction of the man to the data coming in from the external realm. The second is the increase of semantic correlation between knowledge and wisdom as a part of the learning process.

A pass from one semantic level to another takes place under the form of semantics processing. Semantics processing is composed of the following operations: transmitting, editing, calculating, controlling (selections and loops), storing, retrieving, and maintaining. The organized semantics operations create either the regular-manual information system (RIS) or the computer-based information system (CIS). Semantics processing and its paradigms are shown in Figure 4-2.

Data processing organizes a description of transactions into data (data collection, data preparation, data entry, data storing, updating, retrieving, and report generation). The paradigm of data processing is measurement of transactions via so-called Transaction Processing Systems (TPS).

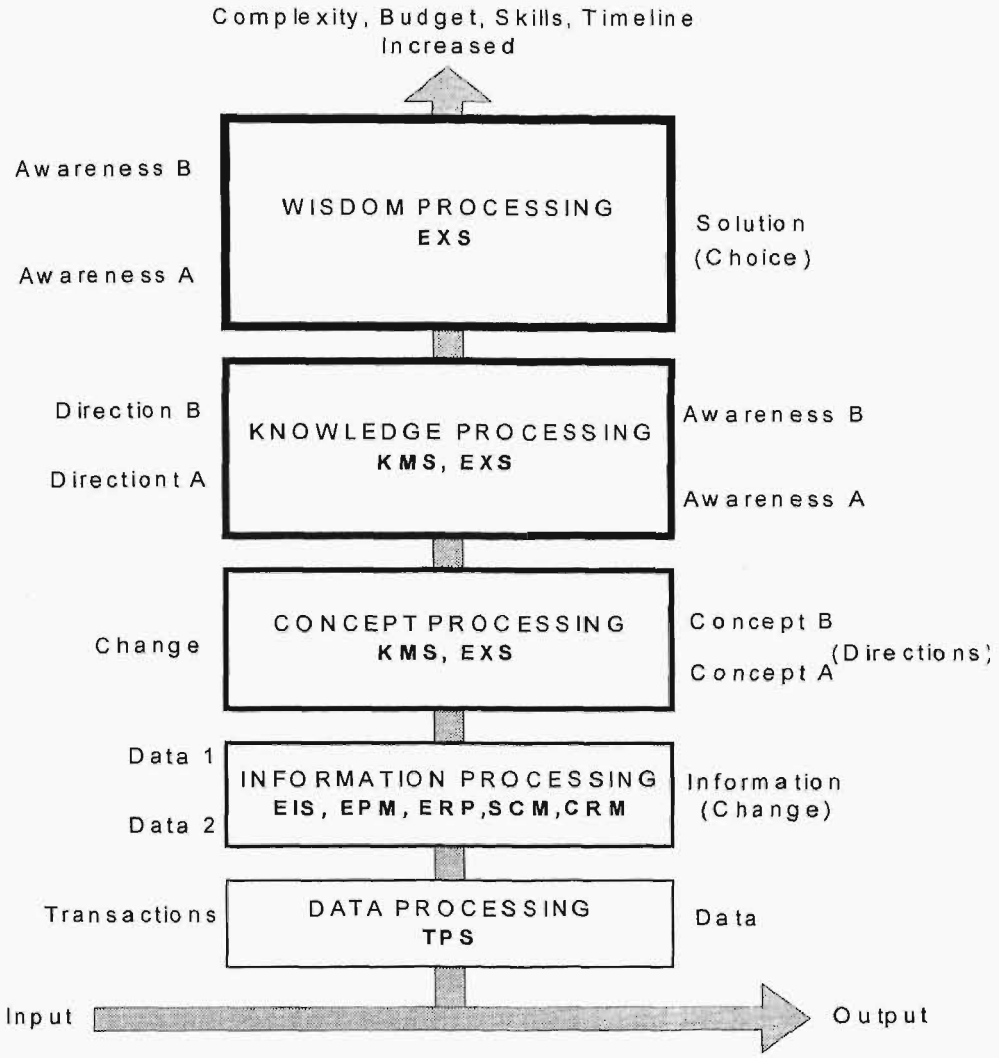
Information processing converts data into information through comparisons of different data sets in order to define a change at the verbal and silent levels. At this level, concepts (ideas) are created which determine a sense of direction. The paradigms of information processing are the assessment of change and direction. In this category fall a majority of the applications, such as Executive Information Systems (EIS), Enterprise Performance Management (EPM), Enterprise Resource Planning (ERP), Supply Chain Management (SCM), and Customer Relation Management (CRM) systems.

Concept processing converts situations into certain levels of affairs (normal, conflict, success, crisis, and failure) that are rules-driven. These systems are Expert Systems (EXS).

Knowledge processing converts data, information, and concepts into rules and a way of reasoning. The paradigm of knowledge is awareness. Through awareness we can verify incoming data, information, and concepts. Do they fit into our frame of reference? Can we use them as a basis for decision-making? Among this category of systems one can mention Knowledge Management Systems (KMS) and Expert Systems.

Wisdom processing converts knowledge into the choice of an action course. The communication frame is created and volition of communication and

Figure 4-2: Semantics Processing by Information Systems



action is expressed. The paradigm of wisdom processing is choice, which can be implemented through Expert Systems.

The knowledge of semantics processing paradigms allowed for the design of correct information systems. We should be "aware" of the requirements from the data processing system. Its purpose is to process transactions and to measure them, nothing more. However, information processing should lead to more advanced systems, such as the Enterprise Performance Management System which can identify the state of the organization (normal, conflict, crisis, success, failure) through the analysis of change ("planned" vs. "actual"). From this analysis, the EPM will create some sort of direction for future courses of action. The output from information processing may pass through the phase of knowledge processing to filter solutions that are correct. Such devices as Data Mining from KMS or Expert Systems (EXS) can be used to create or improve awareness of the decision-maker. At the next level, one can use an Expert System that possesses preprogrammed volition when making a decision. This system provides a way for the choice to be made by the expert in a given field of authority.

It is necessary to notice that the next level of semantic processing requires more complex system architecture, bigger budget, higher skills of developers, and longer time for the system development.

The main purpose of such information systems is to minimize effects of asymmetric information in decision-making. The next section provides the examples of such situations.

ASYMMETRIC INFORMATION

Three Americans won the Nobel Prize for economics in 2001 for research into how the control of information influences everything from used car sales to the boom in its very own motion sensitive-alerts you when high-tech stocks during the 1900's. George A. Akerlof of the University of California at Berkley, A. Michael Spence of Stanford University, and Joseph E. Stiglitz of Columbia University shared the award.

The laureates laid the foundation in the 1970's for a general theory about how players with differing amounts of information affect a wide range of markets. Research into "asymmetric information" gave economists a way to measure the risk, for example, faced by a lender who lacks information about a borrower's creditworthiness.

This sphere of economics deals with situations where agents on one side of the market know something that agents on the other side do not: for example, a seller of a second-hand car may have knowledge of its qualities unknown to a potential buyer. Such situations are very different from those dealt with in the more conventional analysis which assumes that the buyers and sellers have the same information about goods being sold.

It also explored how people with inside knowledge of a high-technology company's financial prospects gain an edge over other investors, while people who don't fully understand a company's finances may invest unwisely. The theory helps economists explain why the recent bubble (1998-2000) in high-technology stocks burst.

Situations of asymmetric information seem to be widely prevalent in the real world, so that moving beyond the conventional analysis yields fascinating and handsome awards.

A good introduction to the idea of asymmetric information is provided by the well-known story of Solomon's wisdom (Hillier, 1997). In this story, King Solomon, in a dream, has his wish for "an understanding heart to judge the people, that I may discern between good and bad" granted by God. Solomon's wisdom is illustrated by a story concerning two women who appear before him seeking judgment.

Two women have a young baby with them and each claims to be its mother. Each woman claims that although the other woman also gave birth to a baby it died in the night, and that the other woman is the mother of the dead child and not of the living one. Solomon responds to the women's contradictory claims by instructing a servant to bring a sword and divide the child in half.

On hearing Solomon's command, the true mother of the child responds by saying she is not the mother of the child and that it should be given to the other woman. The other woman says that the child indeed should be divided in two. Solomon is then able to tell who is the real mother and instructs that the child should be not killed but given to the true mother, who was prepared to give it away rather than see it die.

This story illustrates a number of points which explain the idea of asymmetric information. First, there is a clear asymmetry of information: the women knew whose baby if the child is, but Solomon does not. Second, there is a conflict of objectives; Solomon would like to have the information that is available to the women in order to better achieve his goals. Third, the true mother would like to transmit the information but cannot easily do so because of the actions of the other woman, who also lays claim to the child. Finally,

Solomon devises a contract to offer the women, which causes them to reveal him.

This case illustrates the points that are characteristic of many market situations. For example, an insurance company offering accident insurance to car drivers, some of whom are naturally more cautious and less accident-prone than others. The insurance company is like Solomon because it cannot tell who a safe driver is and who is a risky one, but it would like to be able to do so in order to charge higher premiums to riskier drivers. The drivers are like the women, since both safe and risky drivers will claim to be safe to try to obtain cheaper insurance. Thus the insurance company, like Solomon, has to try to devise a contract to offer the drivers which will cause them to reveal themselves truthfully. Unlike Solomon, the insurance company is unlikely to be able to solve its problem perfectly. In practice, the presence of the risky drivers prevents the safer ones from getting as good an insurance deal as they would otherwise be offered.

The application of information role in macroeconomics begins at the level of the theory of games and its application to the calculations of the price equilibrium by John Nash, who, however, applied symmetric information to all bidders' demand schedules. In a Nash equilibrium all players take the strategies of all the other players as given and learn in the process from the moves of other players. Nash's grounding in economics had taught him that people normally operate so they reach a position of mutual benefits, and he developed systems for understanding these non-zero-sum situations. He also pointed to the differences that exist between situations where competitors sit together and cooperate to produce an outcome and those where there is no cooperation. To sort it out he introduced the concept of an equilibrium point – a collection of the various players' strategies where no individual player can improve his or her outcome by changing strategy. Nash relied on the standard asset pricing theory that all market participants possess the same information. Although, the equilibrium that results under asymmetric information is quite different from one that would prevail under full information.

However, in reality different traders hold different information. Some traders might know more than others about the same event or they might hold information related to different events. Even if all traders hear the same news in the form of a public announcement they still might interpret it differently. Therefore, financial markets cannot be well understood unless one also examines the asymmetries in the information dispersion and assimilation process (Brunnermeiere, 2001). Exploration of the consequences of imperfect

information in economic decision-making is now a standard consideration of economic theorists.

Taking down macroeconomic decisional situations to the microeconomic level (e.g., at the level of traders) of asymmetric information requires two significant departures from conventional analysis. One departure involves recognizing and modeling the various types of asymmetry, and the second involves seeing how the asymmetry affects the nature of the contract entered into by the participants in the market (Hillier, 1997).

At the microeconomic level the analysis of information impact on decision-making took place in the last 30 years in management science under the form of a value of perfect information under certainty and uncertainty. In business communication there is an approach to evaluate media-communicated information richness, which can be interpreted as a value of additional information in perfect decision-making. Both approaches provided the foundation for the development of all sorts of management information systems, including decision-support systems and recently, data mining systems penetrating data warehouses.

The impact of the Information Wave on the examination of economic theories is not unique. One can observe the similar impact upon the theory of physics as well. Since 100 years ago when Albert Einstein developed its famous theory, the role of information was neglected, not felt at all. Even in the further developments in the theory of the atom we do not see any informational considerations. Meanwhile, the whole universe is dynamic and driven by info-communication processes, either observational or hidden.

Summing up, when asymmetric information is taken into account, the economic/business situation becomes an important determinant in decision-making. Gathering information to minimize the effects of asymmetric information is usually costly and can be more effective along with the development of more sophisticated information systems.

The understanding of the role of asymmetric information may lead to further research on how psychological, anthropological, and sociological factors may impact economic/business decision-making. A tool which may help in these undertakings is information technology and its numerous applications.