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A CIIR White Paper

### **TRADITIONAL IS, QUALITY IS AND INTEGRITY IS - A COMPARATIVE STATEMENT**

(A Research & Education Development Direction)

-Draft-

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Research Leader

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 A COMPARATIVE STATEMENT**

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**Table: A comparative statement of traditional information system (Traditional IS), quality information system (Quality IS), and I\*I information system (Integrity IS)**

**1.1 Parameter: Paradigm – Factor System’s Concept**

Technology circumscribed		Beyond Technology
Traditional IS	Quality IS	Integrity IS
<p><b>Technical view:</b>                      (a)System is viewed from a <b>physico-technical angle</b>.                      (b)It is seen as a collection and <b>orderly</b> arrangement of elements or parts.</p>	<p><b>Technical and Behavioral view:</b>                      (a)Like in a traditional IS, system is seen as a collection and orderly arrangement of elements or parts.                      (b)However, it is viewed both from technical and behavioral angles.                      (b)Specifically, the behavioral angle emphasizes political, organizational and human elements that impact systems.</p>	<p><b>Environmental, i.e., Informational view:</b>                      (a)Every physico-technical (i.e. material object contains no less than an infinity of variables (i.e., facts, which are modeled as data, and, when processed, as information), and, therefore, possible systems.                      (b)Further, every system, each of its sub-systems and their components have their own (i.e., local) environment, situation and problem-solving goal.                      (c)In any given system operation, what is, therefore, required is to <i>cull out</i>, i.e., <b>organize</b> – not necessarily physically, but mathematically – and study facts (data and</p>

		<p>information variables) that are relevant to the local environment, local situation and local goal (Usefulness aspect), so as to design and deliver a flexible, customized information decision.</p> <p>(d) This presents a system as a <b>potential source of information</b> in respect of its systems, sub-systems, and components and describes it (system) as a <b>network of information variables in causal relationship to one another and in situations even to themselves.</b></p>
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**1.2 Parameter: Paradigm – Future factor**

Technology circumscribed		Beyond Technology
Traditional IS	Quality IS	Integrity IS
Predictable, Deterministic		Uncertainty, Probability, Possibility

**1.2 Parameter: Paradigm – Future factor**

Technology circumscribed		Beyond Technology
Traditional IS	Quality IS	Integrity IS
Predictable, Deterministic		Uncertainty, Probability, Possibility

**1.3 Parameter: Paradigm – System Complexity factor**

Technology circumscribed		Beyond Technology
Traditional IS	Quality IS	Integrity IS
Complexity of Order		Complexity of Organization
<p>(a) Traditional <i>IS</i> is characterized by the <b>complexity of order</b>. Complexity of order is derived from regularity and repetition.</p> <p>(b) Order contains <b>minimal and structured and periodic</b> (i.e., <b>fixed</b>) information.</p>	<p>Like Traditional <i>IS</i>, Quality <i>IS</i> is also characterized by the <b>complexity of order</b>.</p> <p>(a) Integrity <i>IS</i> is characterized by the <b>complexity of organization</b>.</p> <p>(b) Unlike order, organization always involves “<b>purposiveness</b>” and “<b>end-directedness</b>”. What is central in the end-directedness or purpose of organization is the</p>	

		essential <b>property of control</b> , defined as purposive influence <b>toward predetermined goal (objective)</b> . (c) Integrity <i>IS</i> aims at achieving this control.
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**1.4 Parameter: Paradigm – Change factor**

Technology circumscribed		Beyond Technology
Traditional IS	Quality IS	Integrity IS
Random irritant or nuance (noise a random variable) with known statical moments (mean, variance); within acceptable limits	Periodic irritant or nuance (noise a stochastic process), with known dynamic moments, which are linear, incremental, predictable; within acceptable limits	<i>Continuous adapting to environment as way of life:</i> Challenge of dealing with continuous directional change for improved opportunity or with continuous directional deviation resulting in loss of goal, accelerating, overwhelming

**1.5 Parameter: Paradigm – Information factor**

Technology circumscribed		Beyond Technology
Traditional IS	Quality IS	Integrity IS
Sub-factor - Minimal, Fixed Information		Sub-factor - Maximal, Flexible Information
<b>Emphasis on Minimal, Fixed Information, which is static:</b> (a) Minimal information is technical in nature and accounts for independent, i.e., critical system variables only. (b) Specifically, because the system is seen as composed of a series of components, which are interconnected in such a manner that there is cooperation between the activities of the various components and because this cooperation occurs according to some <b>predetermined set of rules</b> (order), the information requirements of the system are minimal and fixed (structured	<b>Emphasis on Minimal, Fixed Information, which is dynamic, corrupted by noise:</b> (a) In the field of information systems, behavioral paradigm argues that what seems rational and technically correct may not work in an organization due to the existing barriers created by human and behavioral elements within the organization. (b) In Quality <i>IS</i> , accordingly, attention is paid to the type of information systems needed for managing quality. (c) Towards this, as in	<b>Emphasis on Maximal, Flexible Information characterized by Dynamic Decision-Making for Information Use in the presence of Uncertainty:</b> (a) Systems exist in the Real World, which is characterized by the complexity of organization and not order. Further, it (the Real World) is ever changing in that it is not passive but to some extent active. This necessarily creates time pressure and leads to loss of integrity, in the wake of pressure of time-accuracy trade off, which is a <b>dynamic decision-making</b> requirement.

<p>and periodic).</p>	<p>Traditional <i>IS</i>, the system design is based on independent, i.e., critical variables. Further, information is seen as function of source (such information being termed as “fact” or “data”) and, at the most, as function of “source” and “process”, as in communication theory. Its primary value in studying organizational information lies in the key ideas of probability and reduction of uncertainty and notions of noise, lag and error in transmission.                  (d) It is this “noise”, which corrupts the minimal, fixed information and gives it a dynamic and/or random behavior around the fixed information. Quality <i>IS</i> implements information systems, which include data planning and monitoring to improve the quality of this information on a continuous basis.</p>	<p>(b) For systems, above characteristic of the real world is an environmental issue and “information” is the workable organizing phenomenon to deal with it. This emphasizes <i>use</i> aspect of information.                  (c) Information system is composed of sub-systems, namely, the data origin stage, the data processing stage, and the information <i>use</i> stage by the recipient. Further, as observed earlier, every system, each of its sub-systems and their components has its own (i.e., local) environment, situation and problem-solving goal.                  (d) It is common to define information as behavior stimulating response. However, this view has limitation as behavior can be faked. Against this, as argued in (a) and (b) above, <i>information use (IU)</i> to the recipient is a more appropriate measure of information.</p>
<p>Sub factor - Information As A By-Product</p>		<p>Sub factor - Information Is A Product</p>
<p>(c) This leaves the system emphasizing “material” and “energy” processing, and treating the <b>minimal and fixed information, which is static as a by-product</b> (cost center).                  (d) Competitive advantage is thus sought through increased productivity and efficiency, and there is no requirement to “manipulate”, i.e., “optimize” information.                  (e) This renders minimal,</p>	<p>(e) By working with structured and periodic information, whose quality concerns are treated for “process” aspect of <i>IS</i> and not “product” aspect, Quality <i>IS</i> treats <b>information as by-product only</b>, and does not have an analytical framework to decide on the information optimally.</p>	<p>(e) For Integrity <i>IS</i>, what above does is to define information at higher level than in case of Quality <i>IS</i>. Specifically, it (information) then refers to (a) the meaning gained or <i>use</i> made by the recipient, (b) the extent to which uncertainty is reduced and recipient knowledge increased, and (c) the extent to which internal and external environmental (i.e., local market) factors (corresponding</p>

<p>fixed information subjective and function of source; with a static view of environment; and processed in a ballistic manner through ad hoc thumb rules and at the most through trial and error or Repair Service approach.</p>		<p>to each component, sub-system and the system) are further formalized as major factors in information decision for improved system performance. Information in this context is function of source, process and the recipient as represented by the recipient's local environmental factors, individual situation, and problem solving goal.</p> <p>(f) This is a statement of flexible (i.e., unstructured and aperiodic), maximal information, which is a product of dynamic decision-making in the presence of uncertainty. It is local-environment-factor-enriched and aids in delivering improved system operation for recipient, i.e., customer benefit, which is a competitive advantage. By modeling information as a symbolic description having modes of interpreting and interacting with the environment, this facilitates Integrity <i>IS</i> going beyond Quality <i>IS</i>, and treating <b>information as a product</b> and not by-product.</p> <p>(g) This paradigm shift is pregnant with a framework for cost benefit analysis of the purposive influence toward predetermined goal (objective), a much-needed requirement for effective and economic system performance in the presence of complexity of organization.</p>
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**1.6 Parameter: Paradigm – Approach factor**

<b>Technology circumscribed</b>		<b>Beyond Technology</b>
Traditional IS	Quality IS	Integrity IS
<ul style="list-style-type: none"> <li>• Quality, low cost production</li> <li>• Branding, emergent price standards</li> <li>• Diminishing returns</li> </ul>		<ul style="list-style-type: none"> <li>• Be first – best, if possible</li> <li>• Market lock-on, high margins</li> <li>• Increasing returns</li> </ul>

**1.7 Parameter: Paradigm - Economic factor**

<b>Technology circumscribed</b>		<b>Beyond Technology</b>
Traditional IS	Quality IS	Integrity IS
Traditional Economic view is that decision-maker (manager) has limited decision alternatives.		However, Economic view required is that decision-makers face unlimited opportunities coming from every direction. Unexpected opportunities surface every day.

<p>(a) Emphasis on minimal, fixed information suggests decision makers are constrained by the opportunities available to them. Here decision alternatives are generated exogenous to the decision situation. Accordingly, the study of traditional economics is primarily the study of choice among a restricted set of opportunities.</p>	<p>(a) Thus informational view of decision process sees opportunities as alternatives generated <i>endogenous</i> to the decision situation.</p> <p>(b) This is an entirely different perspective. Decision makers face unlimited opportunities coming from every direction. Unexpected opportunities surface any moment.</p> <ul style="list-style-type: none"> <li>- Some are recognized, others are missed.</li> <li>- Some are originated, others are forgotten.</li> <li>- Some are acted upon, others are passed over.</li> </ul> <p>(c) For competitive advantage in a complex and changing environment, this brings into play need to originate information effectively and economically, which in turn requires stimulating and controlling of opportunities.</p> <p>(d) Integrity IS achieves this control by performing within the cost-benefit analysis framework of I*I.</p>
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**1.8 Parameter: Paradigm – Factor *Cost Benefit Analysis Framework***

Technology circumscribed		Beyond Technology
Traditional IS	Quality IS	Integrity IS

<ul style="list-style-type: none"> <li>IS has no explicit coupling to the cost-benefit analysis of the information processed. As a result, there is no analytical method for managers to choose between two quality mechanisms or to decide how much quality is optimally sufficient for strategic advantage.</li> </ul>	<p>(a) IS has explicit coupling to the cost-benefit analysis of I*I. This offers scientific, analytical mechanism to choose between to integrity mechanisms.</p> <p><b>(b) IS for cost-benefit analysis of I*I:</b></p> <p>For simplicity of presentation, only Accuracy attribute of I*I is considered. It is denoted by A(I).          Let,          I(t)=Information,          IUUB=Information Use Upper Bound,          ΔIU(I)= Net information Use Benefit,          α(I)=Usefulness Factor,          β(I)=Usability Factor,          A(I)=Accuracy of I(t)          Then:          Gross IU Benefit=GIUB(I) is given by:  <math>GIUB(I)=[\alpha(I)\times\beta(I)\times IUUB]\times[A(I)]</math>          And ΔIU(I) by:  <math>\Delta IU(I)=GIUB(I)-[COST_{ORIG}(I)+COST_{ANALY}(A(I))+COST_{OPPOR}(A(I))]</math></p> <p><b>Note:</b> it is by choosing optimum A*(I) (i.e., I*I<sub>OPT</sub>(I)) that ΔIU(I), i.e., strategic and competitive advantage is maximized.</p>
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**1.9 Parameter: Paradigm – Cost factor**

Technology circumscribed		Beyond Technology
Traditional IS	Quality IS	Integrity IS
<ul style="list-style-type: none"> <li>Operational optimization</li> </ul>	<ul style="list-style-type: none"> <li>Operational optimization</li> <li>Cost efficiency</li> </ul>	Cost of R&D (information origination a costly activity): <ul style="list-style-type: none"> <li>Cost of information origination</li> <li>Cost of analysing I*I</li> <li>Opportunity cost of analysing I*I</li> </ul>

**1.10 Parameter: Paradigm – Risk factor**

Technology circumscribed		Beyond Technology
Traditional IS	Quality IS	Integrity IS
<p><b>Nature of Risk:</b></p> <ul style="list-style-type: none"> <li>• Moving too quickly – out of control</li> <li>• Risk from component (or system) failing to do its required function.</li> <li>• Risk is a combination of frequency or probability of a specified hazardous event, and its consequence (severity).</li> </ul>		<p><b>Nature of Risk:</b></p> <p>(a) Moving too slowly – out of running</p> <p>(b) Risk from incorrect production of information</p> <p>-Accuracy (A) risk for “T” = {1- A(I)},</p> <p>-Consistency (C) risk for “T”={1-C(I)},</p> <p>-Reliability (R) risk for “T”={1-R(I)}</p>
More on Nature of Risk factor		
<p><b>Risk and Uncertainty:</b></p> <ul style="list-style-type: none"> <li>• Information processing is a decision process. For our purpose, decision-process is same as a decision-making process and includes decision-maker.</li> <li>• Decisions differ in a number of ways. One dimension of decision types, which is useful in information systems, is <b>knowledge of decision outcomes</b>. Three types of knowledge with respect to outcomes are usually distinguished. <ul style="list-style-type: none"> <li>○ <b>Certainty:</b> Complete and accurate knowledge of the outcome of each alternative. There is only one outcome for each alternative.</li> <li>○ <b>Risk:</b> Multiple possible outcomes of each alternative can be identified, and a probability of occurrence can be attached to each.</li> <li>○ <b>Uncertainty:</b> Multiple outcomes for each alternative can be identified, but there is no knowledge of the probability to be attached to each other.</li> </ul> </li> </ul>		<p><b>Risk – An Informational View:</b></p> <p>(a) Concern <i>here</i> is the decision process in a complex and changing environment. (b) Decision process has preferences. Further, decision process is characterized by (i) <i>Ex ante</i> expectation of the decision outcome, and (ii) <i>Ex post</i> decision outcome.</p> <p>(c) What kind of risk will such decision process experience?</p> <p>The risk it can experience is that of making a choice <i>ex ante</i>, which will, according to its <i>ex ante</i> estimate, perhaps turn out to have been sub-optimal <i>ex post</i>. This kind of risk has to be caused by information, which is inexact (noisy) or incorrect (distorted).</p> <p>Effort here is to maintain an <i>ex ante</i>, subjective view from the decision process angle. Even though it chose according to what from its point of view was certainty it (decision process) may have surprise</p>

	<p>waiting for it <i>ex post</i>. But before hand, from its point of view, this risk is captured by the values it estimates (understandably through the I*I Analyzer) for the information integrity attributes of Accuracy (<b>A(I)</b>), Consistency (<b>C(I)</b>), and Reliability (<b>R1(I)</b>) for <b>correctness</b> and of Reliability (<b>R2(I)</b>) for <b>exactness</b>.</p> <p>This is the statement of Information Integrity Risk.</p>
<ul style="list-style-type: none"> <li>• <b>On the nature of decision process for differing Outcome states:</b> <ul style="list-style-type: none"> <li>○ <b>Decision-making under Certainty:</b> If the outcomes are known and values of the outcomes are certain, the decision process computes the optimal alternative or outcome. The optimising criterion may be cost.</li> <li>○ <b>Decision-making under Risk:</b> When only the probabilities of various outcomes are known; instead of optimising outcomes, the decision making process optimises the expected outcome. A basic assumption is that the decision is rational.</li> <li>○ <b>Decision-making under Uncertainty:</b> When outcomes are known but not the probabilities, decision process must be handled differently because, without probabilities, the optimisation criterion cannot be applied. Most suggestions for handling uncertainty are designed to supply the unknown probabilities. Some suggestions are: to assign equal probabilities, minimization of regret, application of game theory (maxmin and minmax criterion).</li> </ul> </li> <li>• <b>How is decision process under uncertainty handled then?</b> <ul style="list-style-type: none"> <li>○ By transforming the Decision Process under Uncertainty into that under Risk, i.e., by treating it as a special case of Decision-making under Risk.</li> <li>○ Thus there is no fundamental difference between the concepts of risk and uncertainty.</li> </ul> </li> </ul>	<p><b>Information Integrity Risk:</b></p> <p>(a) What are the components of the total ex ante risk? They are: (i) Usability Risk, and (ii) Information Integrity Risk, which in turn comprises of (1) Information Correctness Risk and (2) Information Exactness Risk.</p> <p>(b) <b>Usability Risk:</b> In Item 1.8, Equation for IS for cost benefit analysis of I*I considers Usefulness factor <math>\alpha(I)</math> and Usability factor <math>\beta(I)</math>. Both these factors take values between (0,1].</p> <p>When the value of Usability factor is less than 1, Usability Risk comes into the picture. This risk represents not insufficient information about what will happen but insufficient power or insufficient physical capacity of Decision Process to determine what will happen. By itself this risk is irrelevant with respect to determining which action to choose and from the decision process</p>

<ul style="list-style-type: none"> <li> <b>Uncertainty Avoidance/ Risk Aversion:</b>                      Organizations live in uncertain environments. The behavior of the market, suppliers, shareholders, and government is uncertain. The behavioral theory of organizational decision-making assumes that the organization will seek to avoid risk and uncertainty at the expense of expected value. In general, the decision process will be willing to accept a reduction in the expected value of an outcome in exchange for an increase in the certainty of outcome.                 </li> </ul>	<p>angle it represents the limits it (decision process) has to its capacity to determine the realization of outcomes over and between which it has preferences. This risk can be measured as <math>[1-\beta(I)]</math> or as <math>\{\alpha(I) \times [1-\beta(I)]\}</math>, depending on the scale one thinks useful.</p> <p><b>(c)Information Correctness Risk:</b> The Information Correctness Risk is modeled through integrity attributes <math>A(I)</math>, <math>C(I)</math> and <math>R1(I)</math> representing the deduction that decision process, <i>ex ante</i>, should make from its expected increase in competitive advantage (through making a choice) because the information that it bases its choice on is, according to its estimate, to some degree less than totally unbiased (distorted). One way to measure this risk can be: <math>\{1-[A(I) \times C(I) \times R1(I)]\}</math>.</p> <p><b>(d)Information Exactness Risk:</b> The Information Exactness Risk, modeled, of course, through integrity attribute <math>R2(I)</math>, is the estimate of the decision process of "loss", relative to the best otherwise possible according to its information, that it suffers because it has to base its choice on less than sufficient or complete or reliable (i.e., noisy) information. One way to measure this risk can be: <math>\{1-[R2(I)]\}</math>.</p> <p><b>(e)</b>Thus while the information correctness risk represents the <i>ex ante</i> estimate of loss from</p>
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	<p>distorted information, information exactness risk represents the <i>ex ante</i> estimate of loss from noisy information. Whether distorted or noisy, both cases represent incorrect production of information and accordingly information correctness risk and information exactness risk together represent Information Integrity Risk. <i>It is by controlling I*I that these risks can be reduced.</i></p> <p><b>Note 1:</b> At (b) it is mentioned that by itself Usability Risk is irrelevant with respect to determining which action to choose. However, it is worth appreciating that Usability factor and Usefulness factor have their respective information requirements. Information (I) includes all these. And there can be information correctness risk and information exactness risk in respect of information requirements of Usability and Usefulness factors. Therefore, by reducing these risks (i.e., by improving I*I), reduction in Usability risk can be achieved, which will be relevant for decision process in determining choice of the action. However, this relevance of Usability Risk is indirect, and this observation only further establishes relevance of information correctness risk and information exactness risk with respect to determining which action to choose.</p>
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	<p><b>Note 2:</b> Further, as Usefulness factor and Usability factor, both require Information Integrity, under the emerging Usefulness-Usability-Integrity paradigm, this also suggests Information Integrity (I*I) as a fundamental control strategy for maximizing net information use benefit (<math>\Delta IU(I)</math>) for competitive advantage.</p>
<p><b>Risk Aversion is costless to carry and has no requirement for information – exact and correct information is assumed given:</b></p> <ul style="list-style-type: none"> <li>• Decision Processes under Risk and Uncertainty, like that under Certainty, are based on having the knowledge of outcomes with certainty, i.e., on having <b>exact and correct</b> information about decision outcomes. In other words, decision-making process is based on alternatives and outcomes generated <u>exogenous</u> to the decision situation.</li> <li>• These Decision Processes deliver the certain prospect even when expected values are same. To accommodate this, these processes have to assume that every additional dollar brings less and less additional utility.</li> <li>• Consider one such decision process, which has to choose between two prospects with equal expected value, the one certain prospect – say, \$ 1600 – and the other a lottery, contingent on a future “objectively probable” event, say a 40% chance of \$10,000 and a 60% chance of \$-4000.</li> <li>• The decision process has, <i>ex ante</i>, exact and correct information on which to base its choice of a prospect. In other words, the decision making process is certain that there is no way it can obtain additional information and that it has all the information it needs to choose.</li> <li>• The decision process, in this situation, then will choose between two possible actions, leading to two possible prospects, one certain and the other a lottery, based on behavioural preferences and if it conforms to the usual pattern it will prefer the action leading to the certain outcome to the one leading to the lottery.</li> <li>• If the decision process chooses the lottery it will get what amounts to a decision situation with usability</li> </ul>	<p><b>Risk Aversion has requirement for additional information and is a costly activity:</b></p> <p>(a) <i>Clearly, the concept of risk is function of information.</i> This lends risk to have a model- and context- specific interpretation. In the manner of local market (environmental) factor beneficiation, it requires generating alternatives <u>endogenous</u> to the specific decision situation. As a result, there is a paradigm shift in the view of risk from that under expected utility framework.</p> <p>(b) Once again consider the example of a decision process, which has to choose between two prospects with equal expected value, the one certain prospect – say, \$ 1600 – and the other a lottery, contingent on a future “objectively probable” event, say a 40% chance of \$10,000 and a 60% chance of \$-4000.</p> <p>(c) Given the informational view of risk, the decision process can not be <i>ex ante</i> confident or certain that the information it is basing its</p>

<p>factor, denoted by <math>\beta(I)</math>, equal to zero, which means that it cannot be analysed as a decision situation at all: the decision process will be fatalistically indifferent and will not find it worth while to devote decision making resources and capacity to it. It is <i>not</i> a decision situation but a lottery.</p> <ul style="list-style-type: none"> <li>• Of course, aversion of decision process to lotteries may well affect its choice by it choosing certain prospect, but it will not affect its decision-making processes. In this sense, the “classical” risk aversion of mainstream economics is costless to carry, for the decision process, and causes no information demand.</li> <li>• This explains why risk is taken to be the case where probabilities are given (as generated) “exogenously” or “objectively”.</li> </ul>	<p>view of the of the decision situation on is as correct and exact as it can be.</p> <p>(d)Therefore, there is, clearly, a demand for additional information, i. e, individual information origination situation – for increasing <math>I^*I(I)</math>. Unless and until the decision process becomes sure that there is no information that it could obtain which would enable it to choose better it will experience information integrity risk: the <i>ex-ante</i> perceived possibility that devoting additional decision capacity or resources in order to acquire and apply more information to this decision might lead to an <i>ex post</i> more optimal result with regard to its preferences.</p> <p>(e)It is the presence of this information integrity risk (comprising information correctness risk and information exactness risk) that then gives rise to an opportunity cost of decision making in other decision situation(s) (i.e., prospect(s)) which it (decision process) faces, and which compete for its limited information processing capacity – making information origination a costly activity.</p>
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**1.11 Parameter: Paradigm – Value factor**

<b>Technology circumscribed</b>		<b>Beyond Technology</b>
Traditional IS	Quality IS	Integrity IS
(a)In traditional information systems, little attention is	(a)In quality information systems, quality is an	(a)Though in itself a revolutionary approach,

<p>paid to the type of information systems needed for managing quality.</p>	<p>integral goal of an organization with a quality commitment. Within this framework, in dealing with the changing environment, many large and successful corporations take an approach to organizational and functional design that is called <i>reengineering</i> the corporation.</p> <p>(b)It (reengineering) is defined as: <i>The fundamental rethinking and radical design of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed.</i></p> <p>(c)In such undertaking, information systems play a critical role in implementing the innovative and creative approaches in business processes.</p> <ul style="list-style-type: none"> <li>• At the corporate level, information systems play the role of broker, in that almost all creative ways of redesigning business processes require an innovative way of using information systems.</li> <li>• At the functional level, the information-system function looks at its own processes and operations to find out the innovative ways of delivering services to its users.</li> </ul> <p>(d)Corporate level</p>	<p>reengineering as under Quality IS is process centered and not product centered. It requires that information system fit within the business-process design and not other way and thereby does not formalize environment as a major factor in business decisions to achieve increasing returns. It treats information as a by-product and not as product, does not have cost benefit framework, and does not maximize information value.</p> <p>(b) Against this, Integrity IS provides environmental, i.e., informational view of a business process by modeling it (business process) as an integral to a closed loop information and control system characterized by uncertainty. This facilitates treating information as a product as shown in item (c).</p> <p>(c)Let IS process information I(t).          (c-i)For simplicity, consider only Accuracy attribute of information I(t) and denote it by A(I).          (c-ii)Let I<sub>ADDI</sub> denote additional information originated and processed by IS. Further, let A(I<sub>ADDI</sub>) denote accuracy of I<sub>ADDI</sub>.          (c-iii)Then <b>information value</b> I<sub>ADDI</sub> is given by equation:  <math display="block">I_{ADDI} = [\alpha (I) \times \beta (I) \times IUUB(I) \times (1 - [A(I)]) \times (A(I_{ADDI})) - [COST_{OI}(I_{ADDI}) + \{COST_{ANAL}(A(I_{ADDI})) + COST_{OPPOR}(A(I_{ADDI}))\}]]</math></p> <p><b>Note 1:</b> Information value equation is consistent with cost benefit analysis framework defined earlier.</p> <p><b>Note 2:</b> It is by controlling A(I<sub>ADDI</sub>), i.e., I*I that information value I<sub>ADDI</sub> is maximized.</p>
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	<p>reengineering has a top-down policy implication – there is a general design of the business process at the top, and the information system is designed to fit within the business-process design.</p> <p>(e) On the other hand, function-level reengineering is bottom-up process in that the information-system function comes up with innovative methods of service delivery that would add <b>value</b> to the corporation, and has the potential to become an impetus for reengineering business processes.</p> <p>(f)SEU Theory attempts to quantify <b>value</b> of information in monetary terms. It defines the monetary value of perfect information as amount of money, which renders the decision process indifferent between using and not using information.</p>	
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**2.1 Parameter: Model factor I**

<b>Technology circumscribed</b>		<b>Beyond Technology</b>
Traditional <i>IS</i>	Quality <i>IS</i>	Integrity <i>IS</i>
(a)Market perception is limited and protective and perception of customer needs is subjective.	Business drivers are globalization, international competition and changing customer expectations.	Business drivers are globalization, international competition and internal and external customer expectations that are increasingly becoming local and instant.
(a)A closed system view of business process <i>emphasizing</i> material and energy flow, (b)Characterized by commodity products.		(a)An open system view of business process <i>emphasizing</i> information flow, (b)Characterized by

		knowledge-based products.
Input-Output Business Process Model, integral to which are information systems.		A closed loop information and control system, integral to which is a generic business process.
<ul style="list-style-type: none"> <li>• A “collective” decision model, wherein there is no room for local market factor based product beneficiation for strategic advantage,</li> <li>• Standard product in “high” volume business model.</li> </ul>		<p>(a)An “individual” decision model based on local market factor based product beneficiation for strategic advantage.</p> <p>(b)Challenge is that of design and <i>use</i>.</p>
Its origin is in low cost trade practices.	Its origin is in the high-volume mechanical manufacture characterized by inflexible automation for business objectives of operational optimization and cost efficiency.	It aims at “flexible” automation to achieve business objectives of effectiveness and efficiency through requirements of: mass customization, agility – focused on customer responsiveness, IT driven market differentiation, supply chain synchronization by integration maximization, and financial optimization.
Model comprises physical work systems, which emphasize material and energy processing.		Model comprises: (a)informational work system, which emphasizes information ‘transformation’ (as against transfer), and (b)physical work system.
Model has input, process and output systems with ad hoc controls.	Model has input, process and output control systems, which are tuned to “fixed” i.e., “structured and periodic” data/information decisions.	Model is based on “flexible” information decision for control implementation for physical work system.
<p>Main <i>IS</i> concern is <i>only</i> that convenient information is accessed.</p> <ul style="list-style-type: none"> <li>• <i>IS</i> has no transparency</li> </ul>	<p>Main <i>IS</i> concern is <i>only</i> that information technology accesses, communicates, processes and distributes the already generated information.</p> <ul style="list-style-type: none"> <li>• <i>IS</i> has limited transparency – normally operational level.</li> </ul>	<p><i>IS</i> concern is information origination and processing “<i>endogenous</i>” to the decision situation.</p> <ul style="list-style-type: none"> <li>• <i>IS</i> emphasizes complete transparency – strategic, control and operational level.</li> </ul>

Information processing is ad hoc, non-analytical and predetermined.	Information processing attends <i>only</i> to the “exactness” aspect of information requirement and accordingly accounts for implications of noise present in the information.	Information origination and processing has a need to attend to “correctness” aspect of information requirements, which includes “exactness” aspect. Accordingly, IS has a need to account for incorrect production of information due to “distortion” and “noise.”
<i>Information is not of particular value.</i>	<i>Assumption is that data is perfect, once validated, and most information processing systems do not anticipate defective data.</i>	<i>In the presence of uncertainties due to system environmental factors, it is not acceptable that data is assumed perfect, once validated, and that most information processing systems do not anticipate defective data.</i>

**2.2 Parameter: Model factor II**

<b>Technology circumscribed</b>		<b>Beyond Technology</b>
Traditional <i>IS</i>	Quality <i>IS</i>	Integrity <i>IS</i>
There is <u>no</u> requirement to originate local market factor based information on decision alternatives and on selection of information decision <i>endogenous</i> to decision situation.		There is a continuous requirement to originate local market factor based information on decision alternatives and on selection of information decision <i>endogenous</i> to decision situation.
<p>(a)IS processes “minimal” information. This ends up treating information as by-product.</p> <p>(b)These minimal information requirements are:</p> <ul style="list-style-type: none"> <li>• For Traditional IS: <ul style="list-style-type: none"> <li>○ Information requirements for processing structured and periodic information decision at various process control levels;</li> <li>○ Information requirements for processing inputs as per control signal to deliver product/system/service to the direct user.</li> </ul> </li> <li>• For Quality IS: <ul style="list-style-type: none"> <li>○ Input data on current basis in the form of requirements of: <ul style="list-style-type: none"> <li>▪ Recipient, i.e., customer,</li> <li>▪ Business process capabilities and</li> </ul> </li> </ul> </li> </ul>		<p>(a)IS has a requirement to originate and to process “maximal” information. This enables treating information as product.</p> <p>(b)For Integrity IS, these maximal information requirements are:</p> <ul style="list-style-type: none"> <li>(i) Of describing Business Process Goal; <ul style="list-style-type: none"> <li>a. Includes information requirements in respect of failings and malfunctions that may not exist</li> </ul> </li> </ul>

<p>costs,</p> <ul style="list-style-type: none"> <li>▪ Questions, etc.;</li> <li>○ Information requirements for processing on current basis input data obtained as above for generating structured and periodic information decision;</li> <li>○ Information requirements for processing structured and periodic information decision at various process control levels;</li> <li>○ Information requirements for processing inputs as per control signal to deliver product/system/service as per customer specification.</li> </ul>	<p>at the moment but will emerge with delay (evolutionary situations)</p> <ul style="list-style-type: none"> <li>▪ For example: ergonomic failures;</li> <li>(ii) Of ‘many factors’ &amp; ‘multiple criteria’ characterizing business task (problem) complexity;</li> <li>(iii) Of operable goal;</li> <li>(iv) Of planning &amp; design constraints and opportunity spaces;</li> <li>(v) Of <i>culled out</i>, i.e., useful (relevant) information variables;</li> <li>(vi) Of critical, i.e., independent information variables;</li> <li>(vii) Of interconnections, i.e., relationships (interdependencies) between <i>culled out</i> information variables;</li> <li>(viii) Of input data on current basis in the form of requirements of:             <ul style="list-style-type: none"> <li>○ Recipient, i.e., customer,</li> <li>○ Business process capabilities and costs,</li> <li>○ Questions, etc.;</li> </ul> </li> <li>(ix) In respect of processing on current basis input data obtained as above for generating decision situation specific flexible information decision;</li> <li>(x) In respect of processing</li> </ul>
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	<p>information decision at various process control levels; and</p> <p>(xi) In respect of processing of inputs as per control signal to deliver product/ system/service as per customer (direct user) specification.</p>
<p>Strategy for competitive survival does not demand committing of organizational resources for information “origination”.</p>	<p>Strategy for competitive survival requires committing of organizational resources for information “origination”.</p>
<p>With information technology costs ever decreasing, information processing for decision-making is taken as a <i>costless</i> activity.</p>	<p>Information origination is a <i>costly</i> activity.</p>
<p>Model assumes complete knowledge of initial condition (i.e., fixed information decision for control implementation).</p>	<p>Model has incomplete knowledge of initial condition (Flexible information decision with uncertainty for control implementation).</p>
<p>Model assumes linearity of process.</p>	<p>Model has non-linear processes.</p>
<p>On the part of the business enterprise system, its sub-systems and their components, the model assumes availability of unlimited (i.e., adequate) information processing resources.</p>	<p>On the part of business enterprise system, its sub-systems and components, the model considers the inadequacy of information processing resources. This is because information origination is a costly activity. This makes all decision processes (Ref. Items (8) and (11)) identified under Integrity IS costly activities.</p>

<b>Error Model</b>	
<p>(a) Model recognizes errors in respect of “exactness” aspect of information processed.</p> <p>(b) This error accounts for implications of “noise.”</p> <p>(c) An error is defined as a deviation from the required (standard) function/operation of the component, sub-system, or the system.</p> <p>(d) Accordingly, an error is the mechanism by which the fault becomes apparent, i.e., observable.</p> <p>(e) The system failure concern is only in terms of functional, i.e., observable failures.</p>	<p>(a) Model has a requirement to recognize errors in respect of “correctness” aspect of information processed.</p> <p>(b) This accounts for implications of “distortion” and “noise”.</p> <p>(c) An error is defined as a failure to ensure an optimum, desired, or intended value (for a view, format, variable, or process, etc. as the case may be) that is correct given the circumstances (situation), the cause and form of error notwithstanding. An error can occur only if there is an appropriate identified source of value (standard) to ensure on the basis of a documented state of events.</p> <p>(d) The system failure concern goes beyond functional, i.e., observable failures and includes Decision Failures from:                      -Design errors, Development errors, Deployment errors, Data errors and Detection errors,                      -Errors in originating maximal information requirements, etc.</p> <p><b>Note:</b> These errors, which in fact are information errors, and decision failures therefrom, both, are unobservable. It is risks from these decision failures that are crucial to loss of strategic advantage.</p>

**3. Parameter: People**

People Factor	<b>Technology circumscribed</b>		<b>Beyond Technology</b>
	Traditional IS	Quality IS	Integrity IS
Focus	Users: Immediate with direct access	Customers: Internal as well as External	Internal and external customers with their operating

			environments identified (local market factors).
Leadership	(a)Micro-management of strategic plan to end state. (b)Centralized decision making with little responsibility.	Macro-management of strategic plan to end goal. (b)Owning centralized decision-making with responsibility.	(a)In the mould of Teacher-Scientist: Envisioning and coaching on direction. (b)Owning distributed decision-making and responsibility.
Commitment	Project-based	Vision-based	Evolving and sustaining.
Communication	One-way	Two-way	All directional; Responsive to the environment in that communication is environment (local market factor) interactive.
Involvement	Special	General	Research
Recognition	Sporadic	Systematic	Holistic and Systemic, A Team Phenomenon
Teamwork	-Project-based, -Emphasis on application of raw energy, processing of resources and maximizing productivity.	-Broad-based, -Emphasis on processing of material and energy resources, repetitive day-to-day operations, and optimization of quality and productivity.	-Group integration, -Emphasis on adaptability, quest for innovation, application of ideas, and processing of information.
Training	Users Only	Universal	Interdisciplinary, Systems Methodology, Integrated view of knowledge

**4. Parameter: Organization**

Organization Factor	Technology circumscribed		Beyond Technology
	<i>Traditional IS</i>	<i>Quality IS</i>	<i>Integrity IS</i>
Management	Order and Control	Coach and support	Synthesize, Share, and Support
Control	By Others	By Self	Through Self- and Group- Learning
Structure	Hierarchy	Flat	Semi-autonomous

Unit	Single	Multiple	Cell with ability to adapt
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**5. Parameter: Environment**

Environment factor	Technology circumscribed		Beyond Technology
	Traditional IS	Quality IS	Integrity IS
<p><b>Organizational Environment:</b>                      This covers physical and functional resources available to deal with the system problems (failures). These resources are based on closed system view of the system and include informational resource, which supports pre-determined information decisions identified exogenous to the problem situation. Accordingly, organizational environment is also termed as direct or concrete environment. Anomaly in the organizational environment is modeled as a statistical noise in these system resources. Descriptively, presence of noise is the issue of inexactness from the pre-determined value.</p>	<p>(a) System, its sub-systems and their components are described by their critical, independent variables only.                      (b) Further, the view of internal and external environments corresponding to them is subjective, ad hoc and static.                      (c) This leaves solutions to deal with systems problems (failures) emphasizing physical resources.</p>	<p>(a) Like in Traditional IS, in Quality IS, also, system, its sub-systems and components are described by their critical, independent variables. However, unlike Traditional IS, it (Quality IS) views them both from technical and behavioral angles.                      (b) To account for varying (noisy) customer expectations, this facilitates a view of internal and external environments, which is subjected to random and linear incremental changes in fixed, completely known information decisions at various levels.                      (c) This provides the basis for the design phase of quality information system, which includes two additional aspects that are normally missing in the design of traditional information systems: <b>reliability and robustness</b> and requires that major</p>	<p>(a) In Integrity IS (in addition to their critical, independent information variables) the system, its sub-systems and their components are described by their local market factor based environmental variables, which are non-critical in that by themselves they exercise very little influence on the system function but in conjunction with other variables they impact critical system variables (and system function) in variety of ways.                      (b) This introduces consequences of incorrect system operations arising from production of incorrect information due to loss of Content Integrity, Process Integrity and System Integrity and presents an informational view of the system environment.                      (c) This leads to all participants in each of the system-development-and-</p>

		<p>participants in the subsequent SDLC model phases take part in the design phase, and plan for their functions as the design progresses.</p> <p>(d) This leaves solutions to deal with systems problems (failures) emphasizing physical and functional resources.</p> <p><b>Note:</b> Quality paradigm improves functional global performance in a global organization. As with a business process, information system is also described by functional areas. In the manner of Quality IS, this constitutes a basis for application of quality paradigm to information system.</p>	<p>implementation-life-cycle (SDILC) model phases under Integrity IS being concerned with the remaining phases <i>also</i>. As phase progresses, requirement is to plan for decisions and actions with respect to that phase as well as other (phases).</p> <p>(d) This facilitates each SDILC model phase of Integrity IS recognizing continuous interaction among complex systems and including additional aspects that are missing in the design and implementation of quality information system: <b>accuracy</b>, <b>consistency</b> and <b>reliability</b> of information system and of information therefrom.</p> <p>(e) This leaves solutions to deal with systems problems (failures) emphasizing physical and functional resources (over and above those for Quality IS) with reference to:</p> <p><b>-Standard for Factor of environmental interdependency:</b>          Dictionary of standard knowledge (environmental, i.e., local market) factors</p>
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			<p>with standard models of relationships between them illustrating problem solving in different contexts,</p> <p><b>-Standard for Factor of recognizing environmental anomaly:</b> Standard descriptions of contexts in which the incident occurs and the way the incident evolves activating certain knowledge factors relevant to incident,</p> <p><b>-Standard for Opportunity Space factor:</b> Formally stated Standard Rules and Statements of Limits for Opportunity,</p> <p><b>-Standard for Constraints' Space factor:</b> Standard Defined Sanctions and Standard Credible Threat for Constraints, and</p> <p><b>-Standard for Strategic Goal Factor:</b> Dictionary of Negotiating Standards among interacting goals by selecting or constructing the means to satisfy all sufficiently.</p>
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<p><b>Operational Environment:</b>          Environmental anomalies are also due to <i>distortion</i> in system resources, which in turn have implications of <i>incorrect</i> (as opposed to <i>inexact</i>) production of information. Such anomalies are to be observed in complex and constantly changing environment, which calls for open system view of the system problem. This is the basis for defining an operational environment, which comprises informational resources to deal with system problems (failures and opportunities).</p>	<p>Operational environmental anomalies are not recognized.</p>	<p>(a) Integrity IS recognizes that in complex and ever changing real world, information requirements in respect of above mentioned factors give rise to information origination processes.          (b) Given the ever changing environment that generates time pressure in decision process, given the question of opportunity cost of originating information and given the question of delayed (evolving) consequences of environmental anomalies that start small, these information origination processes are characterized by uncertainty and resulting information errors (and their consequences for the system) at each information origination element (See Item (13) for details of these elements).          (c) This leaves the solutions to deal with systems problems (failures) emphasizing physical and functional resources for each information origination element.</p>
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**6. Parameter: Approach**

<b>Technology circumscribed</b>		<b>Beyond Technology</b>
<i>Traditional IS</i>	<i>Quality IS</i>	<i>Integrity IS</i>
Static	Dynamic	Dynamic Decision Making
Subjective	Fact-based  <b>Note:</b> Information, when seen as a function of source (or at the most of source and process as in the communication theory) is defined as fact or data.	Information based  <b>Note:</b> At the higher level of information processing, information is a function of source, process and recipient (i.e., customer or user).
<ul style="list-style-type: none"> <li>• Supply Push</li> <li>• Capacity to deliver</li> </ul>	<ul style="list-style-type: none"> <li>• Demand Push</li> <li>• Capacity to deliver as per demand</li> </ul>	<ul style="list-style-type: none"> <li>• Push and Pull</li> <li>• Capacity for change and to deliver as per demand</li> </ul>
<b>Good-Enough Reliability:</b> Focus of error discovery more on observed failure.	Zero Error: (i) Prevention: prevent errors from occurring (ii) Detection: search for errors while the system is working (iii) Failure: wait until the system fails	Systems approach to error minimization (This approach considers design of objects, activities, rules and procedures, norms, commands, and patterns of behavior as being the source of errors): (i)Anticipation: anticipate errors at decision stage itself (ii)Correction: correct decision errors (ii)Failure: not acting to correct decision error as soon as it occurs and saving system from occurrence of (even delayed) functional failure.
Direct Cost: (a) Forms the basis of resource allocation to various components of the system. (ii) <b>Reliability</b> of the system is considered an additional cost, requiring time and money.	Cost of Ownership: (a) Taguchi’s concept of loss function considers system-wide costs due to failure of the product to perform according to its requirements. (b) In quality information systems, the cost of the system ownership includes future maintenance and <b>loss due to</b>	Cost of Origination: (a)It comprises the cost of origination of information (I), of analysing I*I, and of opportunity cost of analysing I*I, (b)In other words, faced with the need to be continuously responsive to the environment (i.e., local market factors), in

	<b>lack of reliability.</b>	integrity information systems, the cost includes cost of information origination and <b>loss due to origination of incorrect information.</b>
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**7. Parameter: Process factor of Strategy**

<b>Technology circumscribed</b>		<b>Beyond Technology</b>
<i>Traditional IS</i>	<i>Quality IS</i>	<i>Integrity IS</i>
Plan	Plan for Vision	<ul style="list-style-type: none"> <li>- Plan both for Vision and Continuous Local Market (Environmental) factor beneficiation in an interactive manner.</li> <li>- Macro and Micro Integrity is the key.</li> <li>- Plan for Desired (Optimum) Integrity Vision.</li> </ul>

**8. Parameter: Process factor of Analysis**

<b>Technology circumscribed</b>		<b>Beyond Technology</b>
<i>Traditional IS</i>	<i>Quality IS</i>	<i>Integrity IS</i>
User Requirements	Voice of customer (internal and external) and application of techniques such as quality function deployment (QFD) and analytic hierarchy process (AHP), which provide a formal structure for requirements analysis in information systems.	<p>(a)Purpose is to provide a formal structure for requirements analysis of information systems, their sub-systems and components at data origin stage, at processing stage (transforming data originated into information), and at the stage of information use by recipient.</p> <p>(b)This is achieved with the help of (i) continuous local market (environmental) factor beneficiation and (ii) application of information origination techniques. By dealing with environmental anomalies, this formalizes</p>

		<p>internal and external environments as major factors in decisions at each of SDILC model phases. Quality IS does not feature this process factor.</p> <p>(c) Finally, information origination techniques applied include:</p> <p>(1) To account for changing environment (i.e., environmental anomaly), at each phase of SDILC model, there is continuous observation and re-evaluation.</p> <p>(2) And, at each SDILC model phase, following the observation and re-evaluation, there is information origination comprising following decision activities:</p> <ul style="list-style-type: none"> <li>-Explicit and implicit problem solving goals established continuously and 'many factors' &amp; 'multiple criteria' originated (complexity factor) <b>(D1)</b>,</li> <li>-Operable goal obtained <b>(D2)</b></li> </ul> <p><b>Note:</b> Activities at D1 and D2 include decision activities with respect to failings and malfunctions that may not exist at the moment but will emerge with delay (evolutionary situations) - For example: ergonomic failures;</p> <ul style="list-style-type: none"> <li>-Risks evaluated and for them opportunity and constraining spaces finalized <b>(D3)</b>,</li> <li>-Relevant information variables culled out (Usefulness factor of information) <b>(D3)</b>,</li> <li>-Interdependencies between information variables established <b>(D4)</b>,</li> </ul>
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		<p>-Prediction models for information variables followed by the State Space Model, i.e., Integrity <i>IS</i> model developed (D5).</p>
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**9. Parameter: Process factor of Design**

<b>Technology circumscribed</b>		<b>Beyond Technology</b>
Traditional <i>IS</i>	Quality <i>IS</i>	Integrity <i>IS</i>
<p>Sequential:  <b>(a)</b>The design phase is just one phase in the sequential system life cycle.  <b>(b)</b>Design defects and manufacturing errors fixed by imbedded iterative trial and error approach.</p>	<p>Concurrent:  <b>(a)</b>In quality systems, major participants in the subsequent phases take part in the design phase, and plan for their functions as the design progresses.  <b>(b)</b> Design teams are cross-functional.  <b>(c)</b> The design phase of quality information systems includes two additional aspects that are normally missing in the design of traditional information systems: <b>reliability and robustness.</b></p>	<p>Integrative and systemic:  <b>(a)</b>In integrity systems, all participants in each of the system-development-and-implementation-life-cycle (SDILC) model phases are concerned with the remaining phases <i>also</i>.  <b>(b)</b>As a result, as phase progresses, participants plan for their decisions and actions with respect to their own phase as well as other (phases). This facilitates recognizing continuous interaction among complex systems.  <b>(c)</b>Also, integrity information systems recognize the system requirement to adapt to the environment as it changes over time (real world is ever changing).  <b>(d)</b>Features at (b) and (c) above are the basis for integrity information system focusing on internal and external customers with their operating environments identified (local market factors). (See people parameter at Item (3)).  <b>(e)</b>For integrity information systems, this facilitates emphasizing environmental (local market) factors as</p>

		<p>critical to minimizing system failure consequences of incorrect production of information. This requirement is completely absent in quality information systems.</p> <p><b>(f)</b> As a result, each SDILC model phase of integrity information system includes additional aspects that are missing in the design and implementation of quality information system: <b>accuracy, consistency and reliability</b> of information system and of information there from.</p>
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**10. Parameter: Process factor of Manufacturing**

<b>Technology circumscribed</b>		<b>Beyond Technology</b>
Traditional <i>IS</i>	Quality <i>IS</i>	Integrity <i>IS</i>
<p>Trial and Error:                      (a) Manufacturing of traditional information systems takes place in the form of trial and error until a <b>good-enough reliable</b> system is produced.</p>	<p>Goal is “Right for the First Time”. It requires:                      -An extensive and careful design phase, and                      - <b>Extensive reliability</b> testing at the manufacturing phase.</p>	<p>Goal is to minimize errors in the presence of complex and constantly changing environment. It requires:                      -At each SDILC model phase, considering the respective design of objects, activities, rules and procedures, norms, commands, and patterns of behavior as being the source of errors, and                      -<b>Extensive accuracy, consistency and reliability</b> testing and improvement at each phase.</p>
<p>(a) Emphasis on <b>reliability</b> of hardware and the hardware supplier’s <b>insurance</b> for defect-free and continuously improving hardware service.                      (b) Suppliers are selected based on their reputation, survivability, and price.</p>	<p>There is a demand for a closer relation with the supplier by getting involved, as much possible, with the internal quality efforts of the supplier.</p>	<p>-There is a demand to view each SDILC model phase and each decision stage under it in an integrative and systemic manner as described under Process factor of Design.                      -Emphasis, therefore, is on <b>accurate, consistent and reliable</b> information</p>

		<p>origination and processing, which reduces information correctness risk and information exactness risk.</p> <p>-Suppliers and customers at each stage and level have commitment and responsibility for ensuring integrity.</p>
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**11. Parameter: Process factor of Service**

<b>Technology circumscribed</b>		<b>Beyond Technology</b>
Traditional <i>IS</i>	Quality <i>IS</i>	Integrity <i>IS</i>
<p>Use as is: Unless an error or defect is discovered that would require maintenance, an operational information system is used as is.</p>	<p>Planning and Monitoring: <b>(a)</b> Once a system becomes operational, it is monitored by regular collection of data for early detection of service problems. <b>(b)</b> Monitoring data becomes the basis for process improvement before any major problem arises in the system, hence improving the system on a continuous basis.</p>	<p>Continuous adapting and control: <b>(a)</b>At each SDILC model phase, following the development of the State Space Model, i.e., Integrity <i>IS</i> model, there are following decision activities: -Developing situation specific alternatives for local market factor beneficiation (<b>D6</b>), -Based on alternatives generated as under (D6), selecting Flexible Information Decision for control implementation (<b>D7</b>).</p> <p><b>Note:</b> Decisions (D6) and (D7) represent an unstructured and aperiodic information processing. <b>(b)</b>Situation specific data/information to be processed under the IS for decisions D6 and D7 are then collected and monitored as the basis for decision process controls (by improving integrity at each of decision stages), so as to minimize on continuous basis the possibility of occurrence of</p>

		indirect and direct system errors.
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**12. Parameter factor of Maintenance**

<b>Technology circumscribed</b>		<b>Beyond Technology</b>
<i>Traditional IS</i>	<i>Quality IS</i>	<i>Integrity IS</i>
<p><b>Fire Fighting:</b> In traditional information systems, maintenance is mostly in the form of fire fighting. The discovery of errors is through observed failure.</p>	<p><b>Recovery Plan:</b> Defects and errors are dealt with by prevention and detection. -Prevention of errors by designing <b>reliability</b> into the system, and -Detection of errors through constant field data collection and monitoring via control charts and other statistical techniques.</p>	<p><b>Holistic and Systemic Plan and Control Implementation for Content, process and System Integrity:</b> Indirect and Direct errors at SDILC phases and in information processed therein are dealt by ensuring integrity. -Prevention of SDILC model errors at each stage by ensuring Design Integrity, Development Integrity, Implementation Integrity, Maintenance Integrity. -Detection of errors through constant information monitoring to ensure Goal Integrity, Opportunity &amp; Constraining Spaces' Integrity, Environmental Integrity, Flexible Information Decision Integrity, and Control Implementation Integrity.</p>

**13. Parameter: Techniques Factor**

<b>Technology circumscribed</b>		<b>Beyond Technology</b>
<i>Traditional IS</i>	<i>Quality IS</i>	<i>Integrity IS</i>
Traditional Techniques	Quality Add-on Techniques	Information Systems as Integrity Tools

<p><i>IS</i> concern is <i>only</i> to access ad hoc, convenient information.</p>		<p><i>IS</i> concern is that information technology accesses, communicates, processes and distributes with quality the already generated information (generated at design phase).</p>	<p><i>IS</i> concern is correct and exact information origination and processing “<i>endogenous</i>” to the decision situation at every SDILC model phase.</p>
<p><b>Techniques emphasizing I*I of:</b></p> <ul style="list-style-type: none"> <li>• <b>Decision Process D7</b></li> </ul>		<p><b>Techniques emphasizing I*I of:</b></p> <ul style="list-style-type: none"> <li>• <b>Decision Processes D6, D7</b></li> </ul>	<p><b>Techniques emphasizing I*I of:</b></p> <ul style="list-style-type: none"> <li>• <b>Decision Processes D1 – D7 modeled as information origination processes, and</b></li> <li>• <b>Each of elements of information origination process.</b></li> </ul>
<p>1.Walkthroughs 2.Structured Programming 3.Prototyping 4.Flow Chart 5.Data Flow Diagram 6.Entity-Relationship 7.Normalization 8.Dictionaries 9.Data Modeling 10.CASE Tools 11.Object-oriented analysis (OOA) and Object-oriented design (OOD) 12.PERT</p>	<p>1.Plan-Do-Check-Act 2.Benchmarking 3.Brainstorming 4.Mental Mapping 5.Affinity Diagram 6.Pareto Chart 7.Interrelationship Digraphs 8.Tree Diagram 9.Matrix Diagram 10.Prioritization 11.Quality function deployment (QFD) 12.Cause-and-Effect Diagram 13.Taguchi methods 14.Statistical process control, control charts 15.Simulation</p>	<p>(a) In traditional information systems, little attention is paid to the type of information systems needed for managing quality. (b) In quality information systems, since quality is an integral goal of an organization with a quality commitment, IS includes: Database – Internal and External; Quality Graphs; Standards and Procedures; Communications; Systems for</p>	<p>(a) In quality information systems, little attention is paid to the type of information systems needed to manage system performance in the face of complex, changing environment (i.e., environmental anomalies). (b) For an organization with strategic commitment to compete in a complex and continuously changing market environment, requirement then is for integrity information systems having integrity control as the internal goal. (c) Such Integrity IS would include following information systems for: <b>Integrity of IWS:</b> -IS for Laundry List preparation Stages (Integrity of Decision Processes D1 – D3),</p>

		<p>Certification and Awards</p>	<p>-IS for Influence or Structure Diagram Preparation Stages (Integrity of Decision Process D4),</p> <p>-IS for Structure Characterization (Integrity of Decision Process D5),</p> <p>-IS for Unstructured and Aperiodic Information Processing stages (Integrity of Decision processes D6, D7):</p> <ul style="list-style-type: none"> <li>- Collection and monitoring of situation specific data/information to be processed: (a) for generating alternatives (Integrity of Decision Process D6), and (b) for selecting Flexible Information Decision for control implementation (Decision Process D7).</li> </ul> <p><b>Integrity of PWS:</b></p> <p>-Integrity of information systems as under:</p> <ul style="list-style-type: none"> <li>- Control Implementation IS stages, and</li> <li>- Plant Operation IS Stages</li> </ul> <p><b>(d)</b>Since integrity is a holistic, systemic requirement, Integrity IS is implemented to ensure Goal Integrity, Opportunity &amp; Constraint Integrity, Situation Evolution Integrity, and Local Market Factor Beneficiation Integrity for competitive advantage.</p> <p><b>(e)</b>Further, it (Integrity IS) is also implemented to ensure Design Integrity, Development Integrity, Deployment Integrity, Data Integrity, and Detection Integrity, all these</p>
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			<p>leading to further competitive advantage.</p> <p><b>(f)</b>Each of information systems under Integrity IS is an information origination process comprising following elements:</p> <p><b>Element 1:</b> Observation of the Real World Events</p> <p><b>Element 2:</b> Verification of Problem Area Data Observed</p> <p><b>Element 3:</b> Problem Recognition or Operable Goal Setting</p> <p><b>Element 4:</b> Prediction of Future States</p> <p><b>Element 5:</b> Coordination of information origination activities with reference to:</p> <ul style="list-style-type: none"> <li>-Attending to data,</li> <li>-Prioritization of problems and activities,</li> <li>-Selection of flexible information decision,</li> <li>-Control implementation,</li> <li>-Reevaluation</li> </ul> <p><b>Element 6:</b> Selection of Flexible Information Decision and Control Scheduling</p> <p><b>Element 7:</b> Input-process-Output Implementation</p> <p><b>Element 8:</b> Reevaluation</p> <p><b>Element 9:</b> Information origination resource management</p> <p>What is important is each of these elements is also affected by uncertainty and hence information errors, which in turn lead to decision errors and SDILC model phase errors necessitating Integrity IS identified as at items (d) and (e) above. This makes information errors arising from incorrect information processing at</p>
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			<p>element level as fundamental or core IS Errors. Ensuing integrity requirements as under items (d) and (e), therefore, requires developing Integrity IS for each of above elements.</p> <p>This requirement leads to implementation of <b>feedback control system based I*I Technology</b> throughout the SDILC phases.</p> <p><b>(g)</b>Developing Integrity IS as above would call for:</p> <ul style="list-style-type: none"> <li>-Use of System Dynamics Modeling Methodology,</li> <li>-Use of STELLA Software,</li> <li>-Applications of advanced techniques for plural decision-making (here research can draw on findings from the fields of public decision-making),</li> <li>-Development of Integrity Standards for I*I processes,</li> <li>-Development of “Guide Words” for assessment of Integrity Deviations,</li> <li>-Application of HAZOP technique, etc.</li> </ul> <p><b>(h)</b>Finally, above would lead to development of integrity analyzers which are (a) tuned to generating and analyzing any integrity deviation and (b) capable of identifying its cause and reporting it (deviation) and its cause to integrity controllers for implementing the appropriate control action on IS and on information there from.</p>
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