Importance of Usefulness, Usability And
Integrity Model for Cost–Benefit Analysis

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Abstract: This paper covers the Usefulness, Usability and Integrity (UUI) factor for information system. Which calculates Information Integrity ($I^*I$) value in the context of Cost Benefit analysis for achieving high integrity of information in information system environment. This paper suggests reducing the high integrity risk value by calculating $I^*I$ index value. This paper imposes the usefulness, usability and integrity factor for competitive advantages in control environments. Its determinants are Accuracy, Correctness and Reliability of information improved the decision situation in Information System (IS).

Keywords: Usefulness, Usability and Integrity (UUI), Information Integrity ($I^*I$), Information System (IS), Cumulative Information Integrity Index (CII).

I. Introduction

In complex and changing environment there is a lot of uncertainty in IS. This uncertainty creates a lot of information error in it. This improves complexity of the system with loss of information. This information error maximizes integrity risk value¹. Thus to overcome with loss of information and delay in information processing requires Information Integrity in IS².

1. IMPORTANCE OF INFORMATION INTEGRITY IN IS

Information Integrity ($I^*I$) is dependability and trustworthiness of information and controlling it is a key factor for determining strategic advantage in IS. Its attributes are accuracy, consistency and reliability of IS and information there from¹²³. Information systems have changed a great deal but it is the processes by which these systems are designed and implemented that have changed the most. The majority of them are still comparatively simple in their design⁴. But internal as well as external user aspirations are becoming increasingly local and instant.

2. USEFULNESS, USABILITY, AND INTEGRITY MODEL

Usefulness, Usability and Integrity model of information system used for proving the validity and reliability of Information integrity. Incorrect production of information, origination and processing of information leads to information errors and it embedded into the system difficulty in recognizing complex problems. It avoids the difficulty in recognizing complex goals, which are characterized by interrelated criteria. This UUI model supports to choose and achieve the goal selection on the basis of irrelevant criteria.

3. SIGNIFICANCE OF UUI MODEL

The information origination and processing of information using integrity attributes improves the effectiveness of information system by calculating cost of $I^*I$ value⁴⁵. In this representation IS can be seen as comprising a number of core IS models having data origin stage, data transformation (comprising medium and people), and output stage. Figure 1 shows information integrity system components.
These core IS models may be repeated, paralleled, and interrelated. Output from one core IS model may become input to another. It is recalled that core IS model to which data and information are integral is modeled as a decision process. To outline the cost-benefit analysis methodology of Information Integrity; different decision stages D0 to D22 designed with I*I Technology development in IS[5]. These decision stages improve the efficiency and effectiveness of information value. It gives more accuracy, consistency and reliability of information value in IS. The decision purpose considered to process and convert data as in core IS to deliver information decision stages (i.e. Do to D22) information so as to achieve better information use by calculating I*I attributes in IS. Thus the purpose of processing information through the core IS taken as “improvement in information use”, which in turn gives the strategic or competitive advantage. This control the local and instant requirement of user by processing I*I value, which increases usefulness and usability of I*I index in IS[7].

4. COST – BENEFIT ANALYSIS (CBA)

It is understood that this “improvement” as a variable will be a function of the information (I) being processed under the stage (Si) and can be represented by[ΔIU(I)].

Let IUUB (I) denote the variable giving the upper bound of information use as function of “I”.

Let “α(I)” denote usefulness factor and “β(I)” usability factor. Both factors, functions of “I” takes value between (0, 1] and seen as appropriately defined proportionality variables. The improvement in information use at Stage (Si) is given by Equation[8].

The I*I Benefit Equation is,

\[ ΔIU (I) \bigg|_{S_i} = [α(I) \times β(I) \times IUUB (I)] \bigg|_{S_{i}} \tag{1} \]

This control the local and instant requirement of user by processing I*I value, which increases usefulness and usability of I*I index in IS[7].

II. Methodology

FORMULATION OF I*I

For calculating all benefit equations following notations and formulas used:

i. Cumulative I*I Value=CUM. I*I,
ii. Time unit=T=7 days,
iii. Accuracy Index with respect to time “t”, A_t =A(I)/T,
iv. Improved Real Usefulness=IMPRU=I*I/A_t,
v. Usefulness Factor , α(I)=CUM. I*I/IMPR,
vii. APUI-Apparent Useful Information,
vii. CRUI-Cumulative Real Usability Information,
viii. CPUI-Cumulative Perceived Usability Information,
ix. No. of Observed Records=10,
x. CPUI=CRUI/R,
xii. Usability Factor, β(I)=Cumulative Perceived Usability Information / Improved Real Usefulness (CPUI/IMRR),
xiii. BETA β(I)=CPUI/IMRR.

In reality is different as core IS models are complex, open and impacted by 5 “C” s and they have errors. As a result there is a question about the integrity of information “I”. The accuracy of information considered “A (I)” denotes the concerned Integrity quotient, which takes values between (0, 1]. Then, the gross “benefit” or improvement in information use from processing at stage (Si) would get modified to as in Equation[9].
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The I*I Benefit Equation is

\[ \Delta U(I) | S_i = \{ \alpha(I) \times \beta(I) \times IUUB(I) \} | S_i \times \{ A(I) \} | S_i \] 

This brings the question to that of costs. The correct assessment of benefit from the information processing at the core IS model under consideration could be completed only when, from the gross benefit, the costs of information processing are accounted for. Thus for calculating the gross benefit of I*I value the cost components derived\[10\]. These cost components are consistent with the individual information origination and processing nature of IS. It is suggested that these cost components are those of originating information “I”[denoted by COSTOI (I)], of analyzing integrity quotient of A(I)[denoted by COSTANAL {A(I)}],and the opportunity cost of analyzing A(I) [denoted by COSTOPPORT {A(I)}].

5. COST BENEFIT EQUATION OF I*I

Table 1: I*I Attributes and Weight Functions

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>I*I Attributes</th>
<th>I*I Weight Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>A</td>
<td>Wa 5</td>
</tr>
<tr>
<td>2.</td>
<td>C</td>
<td>Wc 3</td>
</tr>
<tr>
<td>3.</td>
<td>R</td>
<td>Wr 2</td>
</tr>
</tbody>
</table>

(Source: Compiled by Researcher)

Table 2: CIII Attributes Index Value Scale

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Attribute Index Value Range</th>
<th>Scale</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>[1-0.8]</td>
<td>H</td>
<td>5</td>
</tr>
<tr>
<td>2.</td>
<td>(0.8-0.6)</td>
<td>G</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>(0.6-0.4)</td>
<td>F</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>(0.4-0.2)</td>
<td>E</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>(0.2-0)</td>
<td>D</td>
<td>1</td>
</tr>
</tbody>
</table>

(Source: Compiled by Researcher)

a. Integrity Profile for CBA

Consider an information system designed and developed for determining the originating cost in IS. It is appreciated that originating cost, consistent with information usage requirements, will have application area specific order of significance for integrity attributes.

Let Wa, Wc and Wr represent significant weight functions for the integrity attributes accuracy, consistency and reliability respectively, for cost under consideration. These weight functions considered values between (0-10). Let the Information Integrity attribute indices and their respective weight functions as observed at the user end in this specific example is mentioned in the following table 1:

b. Cumulative Information Integrity Index (CIII)

Let Information Integrity attributes, depending on the range in which the attribute index value falls, be assigned a 5 point scale as shown in table 2. In this consideration, the Information Integrity attributes had scales and points as given in table 3.

Table 3: Attributes Scale Points

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Attribute Index Value Range</th>
<th>Scale</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Accuracy Index ( A )</td>
<td>G</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>Consistency Index ( C )</td>
<td>F</td>
<td>5</td>
</tr>
<tr>
<td>3.</td>
<td>Reliability Index ( R )</td>
<td>H</td>
<td>5</td>
</tr>
</tbody>
</table>

(Source: Compiled by Researcher)

Then with a view to quantify the overall Information Integrity Index for this application CIII defined as:

\[ CIII = \frac{4 \times Wa + 5 \times Wc + 5 \times Wr}{Wa + Wc + Wr} \]

If the values of Wa= 5, Wc= 3 and Wr=2 then

\[ CIII = \frac{4 \times 5 + 5 \times 3 + 5 \times 2}{5 + 3 + 2} = 4.5 \]

CIII takes a value between ranges [1-5]. In this situation; it has been observed that this value of CIII is 4.5. It means that the originating cost will be high at this stage. This CIII value for originating cost may be improved with additional requirement of consistency Index having minimum “G” scale. Accordingly then the “net benefit” in the form of improvement in information use as occurring at the information processing stage (S_i) is as given in Equation 3.
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\[ \Delta IU(I) S = \{ (\alpha(I) \times \beta(I) \times IUUB(I) ) \times S(S) \times \{ A(I) \times S \} \} - [ \text{COST}_{\text{OT}}(I)S_{i} + \text{COST}_{\text{ANALY}}(A(I))S_{i} + \text{COST}_{\text{OPPORT}}(A(I))S_{i} ] \] ............................................. (3)

III. Performance Evaluation
IMPORTANCE OF USEFULNESS AND USABILITY FACTOR

Information management process is directly affected through usefulness and usability of information. In this context the decision situations and I\*I rules improves the I\*I value. These dynamic decision situations characterizing the information flow and considerable simplification of the uncertainty at hand will be resolved through it. Let us assume that usefulness factor, \( \alpha(I) \) and usability factor, \( \beta(I) \) to be given, Functions IUUB(I) and A(I) having their own respective first order transients with corresponding steady state (SS) values (here of upper bound value for IUUB(I) and value equal to numerical one for A(I)), and assume all cost functions to be exponentially increasing with time, then from equation 3 the variable \( \Delta IU(I) \) at the stage (S\( _{i} \)) under consideration will have a maximum value at a given time \( t \) and among other things, for a given value of integrity quotient “A”. These equations solved and can be implemented by system dynamics model in further.

IV. Conclusion

In this case it has been observed that there is an optimum I\*I at which:

• Net increase in information use benefit is maximum
• Achieving that I\*I (implying accuracy, consistency, and reliability if they can be quantified) is a costly process.
• To meet the demands of competitive advantage, resource commitment for achieving improved I\*I, optimum I\*I is important.
• The usefulness, usability and integrity play a key role for achieving high integrity value.

References

[9]. V. Rajaraman and Vijay V. Mandke., Information Integrity: Issues and Approaches- Proceedings of the Jawaharlal Nehru Center for Advanced Scientific Research and Supercomputer Education and Research Center, Indian Institute of Science Campus, Discussion Meeting held at Bangalore, India, on 22-23 June 2011.