CHAPTER 2
LITERATURE REVIEW AND THEORETICAL BACKGROUND

2.1. Literature Review

Today, every company has to be able to process a significant amount of information. Since, no business can properly perform any required functions without information system (Thoburn et al., 2000). So that, decide what proper information system suitable to organization needs becomes an important issue whether need technology or not. Most organizations invest substantial investment to improve their information system by spending high budget or using complex system relative to the actual needs, however systematic evaluation to measure their success has been few. Some study already conducted information system success model as shown in Table 2.1., but none of them evaluate interrelation among criteria.

Table 2.1. Research Benchmarking

No	Title	Author	Reference Model	Method	Scale	Location	Information System Dimension								
							SQ	IQ	S	II	OI	U	Sev Q	VQ	NB
1	Quality Assessment of Information Systems in SMEs: A Study of Eldoret, Kenya	(Ndiege, Wayi, & Herselman, 2012)	Delone and McLean (2003)	Qualitative Approach	SMEs	Eldoret, Kenya	✓	✓	✓			✓	✓		✓
2	E-Commerce pada UKM Kota Semarang Sebagai Model Pemasaran yang Efektif	(Solechan, 2011)	Delone and Mc Lean (1992)	SEM	SMEs	Semarang	✓	✓	✓	✓	✓	✓			
3	Measuring the benefits of IS in small organizations in developing countries	(Alshardan, Goodwin, & Rampersad, 2013)	Delone and Mc Lean (2003), Gable et al. (2003)	Mapping using top-down approach	SMEs	Middle East and Africa	✓	✓						✓	✓

4	Model Kesuksesan Sistem Informasi Rantai Pasok di UMKM Handcraft Berbahan Logam di Yogyakarta	(Kusferyano, 2015)	Gable et al. (2008)	ISM	SMEs	Yogyakarta	✓	✓		✓	✓				
5	Identifikasi Variabel Model Kesuksesan Gable di UMKM Kerajinan Gerabah Kasongan Yogyakarta	(Putri, 2015)	Gable et al. (2008)	ISM	SMEs	Yogyakarta	✓	✓		✓	✓				
6	Model Kesuksesan Sistem Informasi Gable pada UMKM Handcraft Kerajinan Kulit di Daerah Istimewa Yogyakarta	(Wulandari, 2015)	Gable et al. (2008)	ISM	SMEs	Yogyakarta	✓	✓		✓	✓				
7	Model Kesuksesan Sistem Informasi Gable pada UMKM Handcraft Kerajinan Kayu di Daerah Istimewa Yogyakarta	(Putra, 2015)	Gable et al. (2008)	ISM	SMEs	Yogyakarta	✓	✓		✓	✓				
8	Model Kesuksesan Sistem Informasi Manual pada Rantai Pasok Industri UMKM Handcraft di D.I. Yogyakarta	(Pratama, 2016)	Gable et al. (2008)	SEM	SMEs	Yogyakarta	✓	✓		✓	✓				

Note: SQ:System Quality; IQ:Information Quality; II:Individual Impact; OI:Organizational Impact; S:Satisfaction; U:Use; SevQ:Service Quality; NB: Net Benefit; VQ:Vendor Quality

Previous research of Delone and McLean identified there was incomplete or inappropriate measure success of information system (Delone & McLean, 1992; Delone & McLean, 2003). They constructed the information system success model consisted of 6 main dimensions which are System Quality, Information Quality, Use, User Satisfaction, Individual Impact, and Organizational Impact; and its sub criteria for each (Delone & McLean, 2003). Delone and McLean information system success model only identified which factors that either affect or are affected the organizational impact and its factors as shown in Figure 2.2.

Ballantine et al. (1996) identified that there is a myopic focus for implementing the information system on finance. It means that general factors that influence the success of an organization cannot be directly used, but it requires an evaluation of organization needs.

Information technology is a tool to process and organize data becomes information. Most enterprises invest technology to improve their business by purchasing particular software without properly measure what the actual necessary is. In fact, most level of information technology success is quite far from satisfactory claimed by academic literature frequently with adoption (Caldeira et al., 2012).

To support the improvement of technology access for Small Scale Medium Enterprises (SMEs), Sinaga et al. (2015) had done early research regarding the adoption of Gable's model which adopted Delone and McLean model to construct new information system model suited to SMEs. Their findings for information success model were using ISM (Interpretive Structural Modeling). The model only identified which factors that either affect or are affected the organizational impact and its factors, but how the factors effectively interplay each other in SMEs has not been discussed.

Kusferyano (2015) identified the relations between the dimensions in which quality system affects information quality, information quality affects the individual impact, and individual impact affects organizational impact. Putra (2015) identified factors that affect SMEs are individual impact (II), organizational impact (OI), system quality (SQ), and information quality (IQ). Putri (2015) identified factors that affect SMEs are System Quality, Information Quality, and Organizational Impact. Wulandari (2015) identified factors that affect SMEs are System Quality, Information Quality, Organizational Impact, and Individual Impact. The previous researches are summarized in Figure 2.1. Putra, Putri, Kusferyano, and Wulandari did their research based on main material used, and then Sinaga, et al., (2015) resulted the model into four clusters which are Manually Unorganized (Cluster 1), Manually Organized (Cluster 2), Semi Computerized (Cluster 3), and Full Computerized (Cluster 4) of Information System.

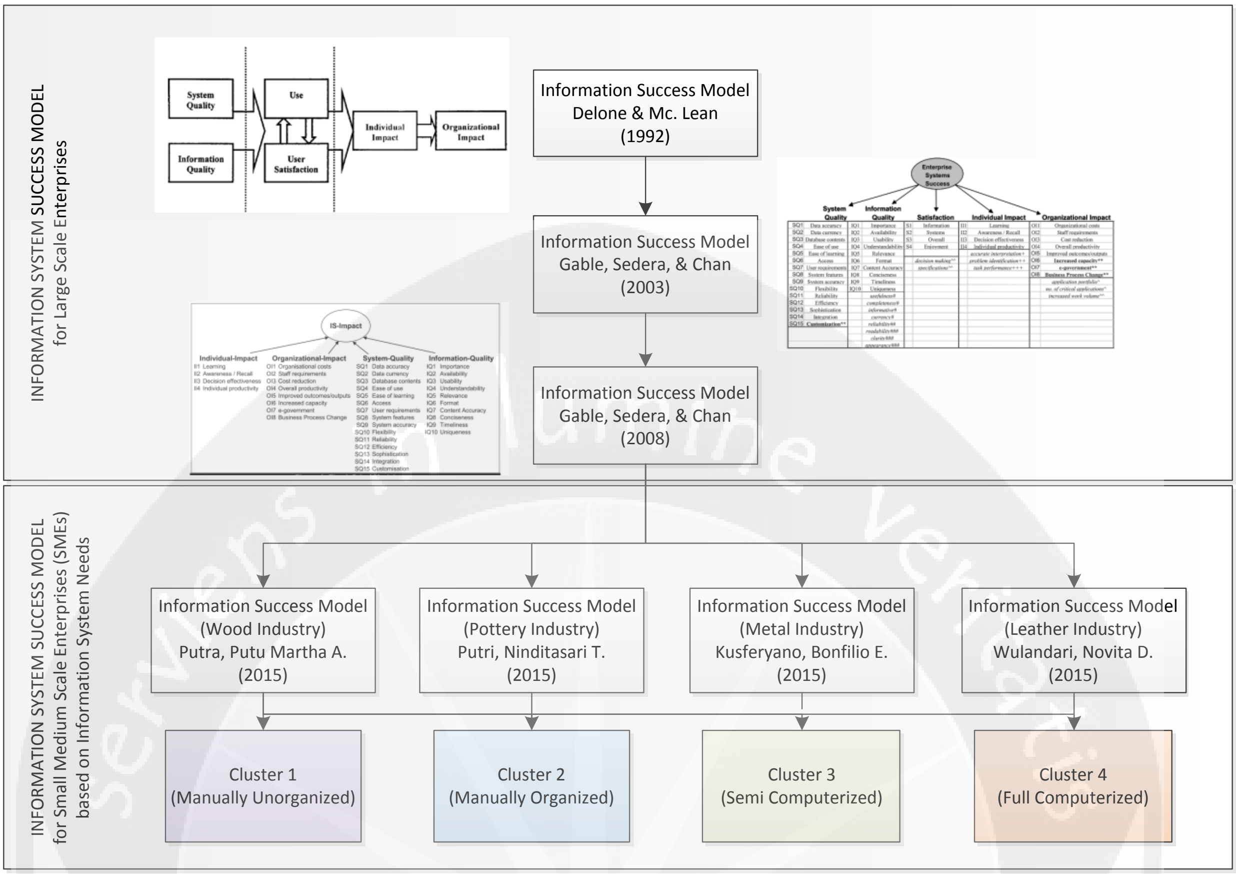

Figure 2.1. Literature Review Summary

The most common problem is the mutual effects of criteria. Hence, it is necessary to identify the criteria which has the greatest impact on other criteria prior to the evaluation, in order to improve the overall performance, as well as the quality and efficiency of the organizational information system (Shih et al., 2013). Shih, et al. (2013) applied Decision Making Trial and Evaluation Laboratory (DEMATEL) to establish the correlation between the mutual effects of the organizational perspectives and used Analytical Network Process (ANP) to determine the weights of the information system and system implementation decision making.

Kurniawati and Yuliando (2015) had done conducted research of identifying factors that significantly influence the performance of SME which responsible to increase the productivity generally. This research mainly focused on SME on food products located at Yogyakarta Province, Indonesia. The analysis in this study combines Decision Making Trial and Laboratory (DEMATEL), and Analytic Network (ANP) as a hybrid Multi-Criteria Decision Making (MCDM) model for evaluating and improving problems related to SMEs performance. Factors such as education, government policy, business competition, and technology are supporting factor that enable SMEs to enhance their competitiveness as well. The most critical factor of the SME performance is human resource as well as the result.

The difference among this study and some previous researches is, this study aims to evaluate and measure specifically the interrelation of information system success model in Cluster 2 of SMEs at Yogyakarta among the influence factors and decide whether they need technology improvement or not. The scope covered in this study is SMEs which manually organize information system at Yogyakarta province.

2.2. Basic Theory

2.2.1. Information System

In 2009, Effy Oz defines what information system is:

> *"The terms 'data' and 'information' do not mean the same thing. The word data is derived from the Latin datum, literally a given or fact, which might take the form of a number, a statement, or a picture. Data is the raw material in the production of information. Information, on the other hand, is facts or conclusions that have meaning within a context. Raw data is rarely meaningful or useful as information. To become information, data is manipulated through tabulation, statistical analysis, or any other operation that leads to greater understanding of a situation.*
>
> *Simply put, a system is an array of components that work together to achieve a common goal, or multiple goals, by accepting input, processing it, and producing output in an organized manner.*
>
> *With an understanding of the terms "information" and "system," the definition of an information system is almost intuitive: an information system (IS) consists of all the components that work together to process data and produce information. Almost all business information systems consist of many subsystems with sub-goals, all contributing to the organization's main goal."*

Based on information system definition above, it's clearly stated that no business could survive without good information system management. How all components interplay to work together to produce information will directly affect the success of organization's main goal. Information is a significantly important for both individuals and organizations. However not all information is useful. Information has to be relevant, complete, accurate, and up-to-date to become useful. Moreover, it should be economically, that is, cost effectively (Oz, 2009).

That is why the way how to find interrelation among the components which affect information system becomes an important issue. Moreover the components should be suitable to the organization needs to find the correct interrelation.

2.2.2. Information Success Model

a. Delone and Mc Lean Information System Success Model

Success model of information system has been developed by some researchers (Bossen, Jensen, & Udsen, 2013; Delone & McLean 1992; Gable et al., 2008; Lee & Chung, 2009; Roky & Meriouh, 2015). Model of Delone and McLean (1992) received much attention from researchers. By 1992 Delone and McLean (Figure 2.2.) discussed “use” and “user satisfaction” are closely interrelated. “Use” must precede “user satisfaction” in a process sense, but positive experience with “use” will lead to greater “user satisfaction” in a causal sense. Similarly, increased “user satisfaction” will lead to increased “intention to use,” and thus “use.” As a result of this “use” and “user satisfaction,” certain “net benefits” will occur. If the IS or service is to be continued, it is assumed that the “net benefits” from the perspective of the owner or sponsor of the system are positive, thus influencing and reinforcing subsequent “use” and “user satisfaction.” These feedback loops are still valid, however, even if the “net benefits” are negative. The lack of positive benefits likely to lead to decrease use and possible discontinuance of the system or of the IS department itself (e.g., wholesale outsourcing). The challenge for the researcher is to define clearly and carefully the stakeholders and context in which “net benefits” are to be measured.

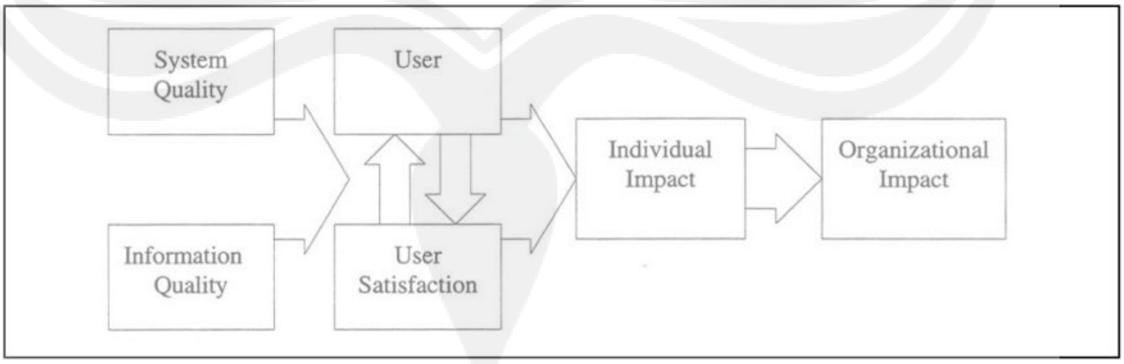

Figure 2.2. Delone and McLean I/S Success Model (1992)

The updated D&M IS Success Model includes arrows to demonstrate proposed associations among success dimensions in a process sense, but does not show positive or negative signs for those associations in a causal sense. The nature of these causal associations should be hypothesized within the context of a particular study. For example, in one instance a high-quality system will be associated with more use, more user satisfaction, and positive net benefits. The proposed associations would then all be positive. In another circumstance, more use of a poor quality system would be associated with more dissatisfaction and negative net benefits. The proposed associations would then be negative as shown in Figure 2.3. (Delone & McLean, 1992).

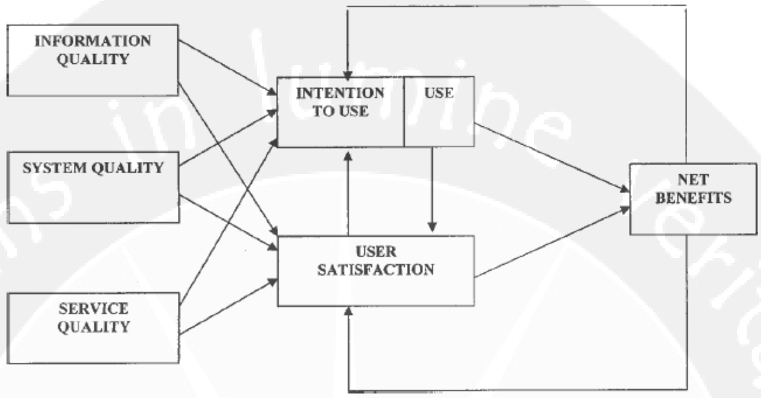

Figure 2.3. Delone and McLean I/S Success Model Updated

b. Gable's Information System Success Model

Gable et al. (2003) developed and revised the model of Delone and McLean (1992). Gable, et al. did research model of success in the information system of 27 public sector in Queensland Australia. In the research Gable were using the approach of dual survey which consists of exploratory inventory survey to identify the dimensions of critical success and model building, then further focused on confirmatory weights survey to evaluate the validity of the model (Gable et al., 2003).

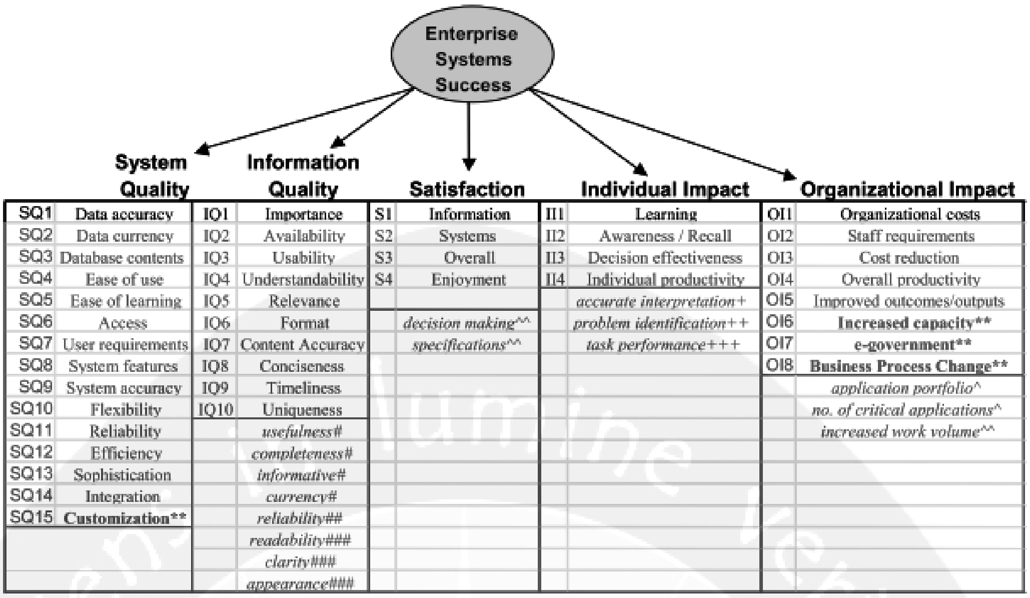

Figure 2.4. Gable's I/S Success Model (2003)

In Gable's final model, the dimensions are divided into four as shown in Figure 2.5. The four dimensions namely Individual Impact, Impact Organization, System Quality and Information Quality. Impact dimension is an advantage gained from the system. Dimensions Quality describe future potential. Dimensions System Quality consists of 15 variables, Information Quality consists of 10 variables, Individual Impact consists of four variables, and Organizational Impact consists of eight variables (Gable et al., 2008). Gable's criteria descriptions are shown in Table 2.3.

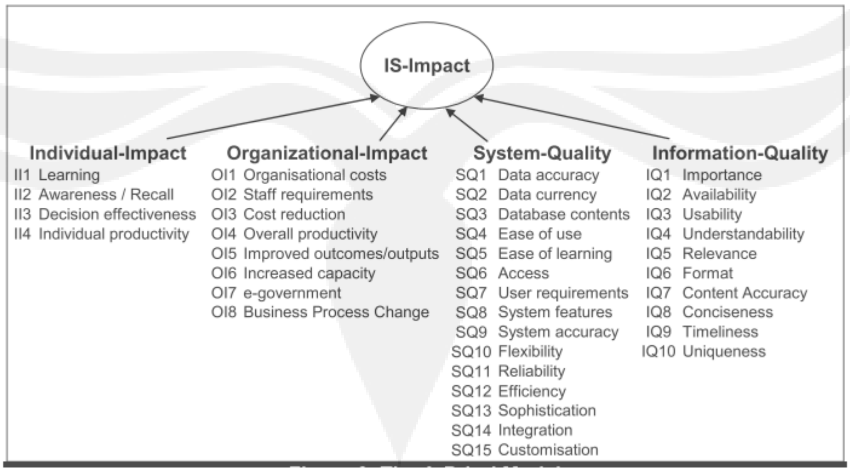

Figure 2.5. Gable's I/S Success Model (2008)

Table 2.3. Information System Success Criteria Definition

Criteria		Definition
System-Quality of the [the IS] is a multifaceted construct designed to capture how the system performs from a technical and design perspective.		
SQ1	Data Accuracy	Data from [the IS] often needs correction
SQ2	Data Currency	Data from [the IS] is current enough
SQ3	Database Contents	[the IS] is missing key data
SQ4	Ease of Use	[the IS] is easy to use
SQ5	Ease of Learning	[the IS] is easy to learn
SQ6	Access	It is often difficult to get access to information that is in [the IS]
SQ7	User Requirements	[the IS] meets [the Unit's] requirements
SQ8	System Features	[the IS] includes necessary features and functions
SQ9	System Accuracy	[the IS] always does what it should
SQ10	Flexibility	The [the IS] user interface can be easily adapted to one's personal approach
SQ11	Reliability	The [the IS] system is always up-and-running as necessary
SQ12	Efficiency	The [the IS] system responds quickly enough
SQ13	Sophistication	[the IS] requires only the minimum number of fields and screens to achieve a task
SQ14	Integration	All data within [the IS] is fully integrated and consistent
SQ15	Customization	[the IS] can be easily modified, corrected or improved.
Information-Quality is concerned with the quality of [the IS] outputs: namely, the quality of the information the system produces in reports and on-screen.		
IQ1	Importance	Information available from [the IS] is important
IQ2	Availability	Information needed from [the IS] is always available
IQ3	Usability	Information from [the IS] is in a form that is readily usable
IQ4	Understandability	Information from [the IS] is easy to understand

Table 2.3. Information System Success Criteria Definition (Continued)

Criteria		Definition
IQ5	Relevance	[the IS] provides output that seems to be exactly what is needed
IQ6	Format	Information from [the IS] appears readable, clear and well formatted
IQ7	Content Accuracy	Though data from [the IS] may be accurate, outputs sometimes are not
IQ8	Conciseness	Information from [the IS] is concise
IQ9	Timelines	Information from [the IS] is always timely
IQ10	Uniqueness	Information from [the IS] is unavailable elsewhere
Individual-Impact is concerned with how [the IS] has influenced individual capabilities and effectiveness on behalf of the organization		
II1	Learning	I learnt much through the presence of [the IS].
II2	Awareness / Recall	[the IS] enhances my awareness and recall of job related information
II3	Decision Effectiveness	[the IS] enhances my effectiveness in the job
II4	Individual Productivity	[the IS] increases my productivity
Organizational-Impact refers to impacts of [the IS] at the organizational level; namely improved organizational results and capabilities.		
OI1	Organizational Costs	[the IS] is cost effective
OI2	Staff Requirements	[the IS] has resulted in reduced staff costs
OI3	Cost Reduction	[the IS] has resulted in cost reductions (e.g. inventory holding costs, administration expenses, etc.)
OI4	Overall Productivity	[the IS] has resulted in overall productivity improvement
OI5	Improved Outcomes/Outputs	[the IS] has resulted in improved outcomes or outputs

Table 2.3. Information System Success Criteria Definition (Continued)

Criteria		Definition
OI6	Increased Capacity	[the IS] has resulted in an increased capacity to manage a growing volume of activity (e.g. transactions, population growth, etc.)
OI7	E-Business	[the IS] has resulted in better positioning for e-Business.
OI8	Business Process Change	[the IS] has resulted in improved business processes

Source:
Appendix B – The Pool of 37 IS-Impact Measures (a-priori model) (Gable et al., 2008).

c. Information Success Model Suitable for SME at Yogyakarta

Based on Gable's I/S success model, Sinaga et al. (2015) conducted research to determine the dominant criteria of IS success specific to Small Medium Enterprises (SMEs) located in Yogyakarta province and to establish relationship among those criteria using Interpretive Structural Modeling (ISM). The interview-based surveys were conducted to several SMEs in Yogyakarta province. On top of that, a cluster analysis based on information system used was done. By substituting the nodes in the final model with the relevant criteria, the ISM model for each cluster as shown on Figure 2.6. - Figure 2.9 were obtained.

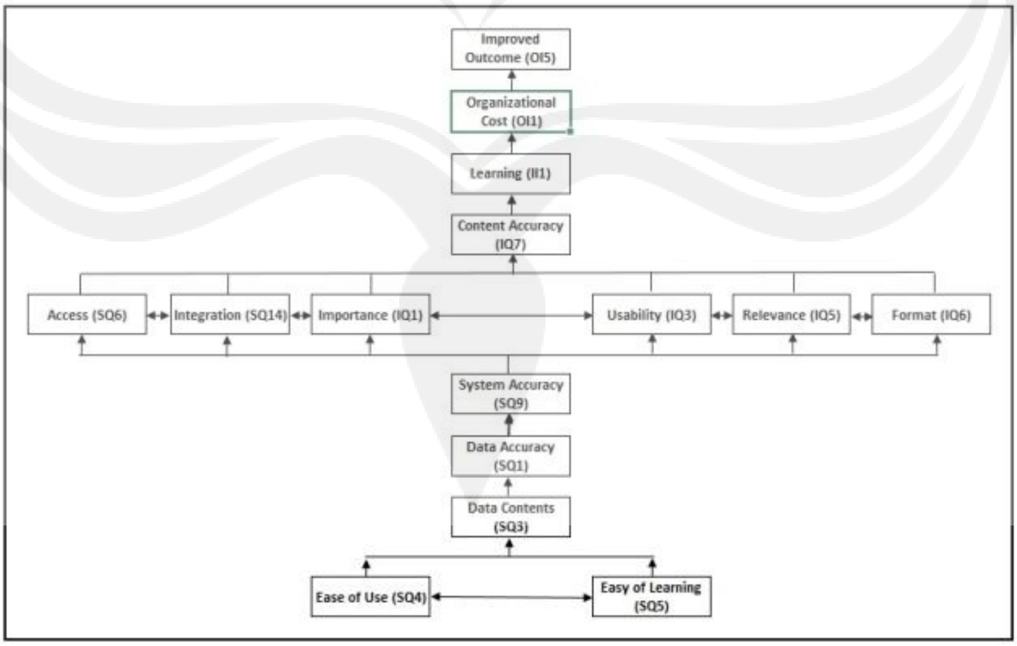

Figure 2.6. Sinaga et al. I/S Success Model of Manually Unorganized (Cluster 1)

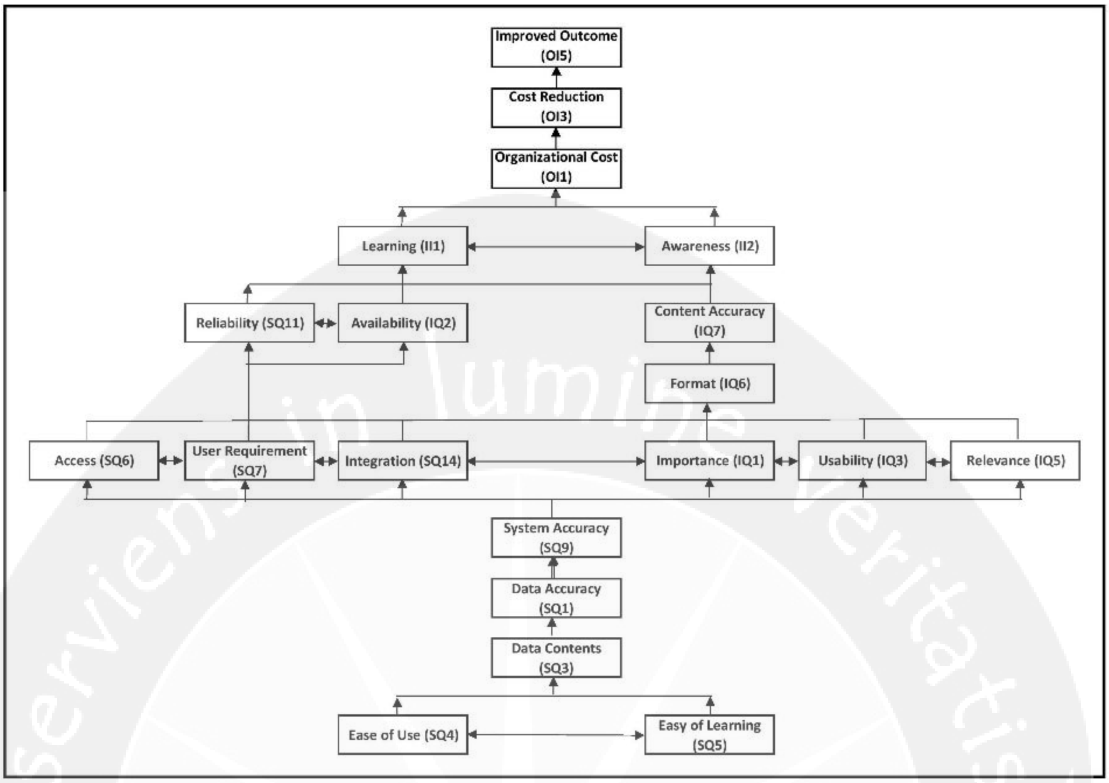

Figure 2.7. Sinaga et al. I/S Success Model of Manually Organized (Cluster 2)

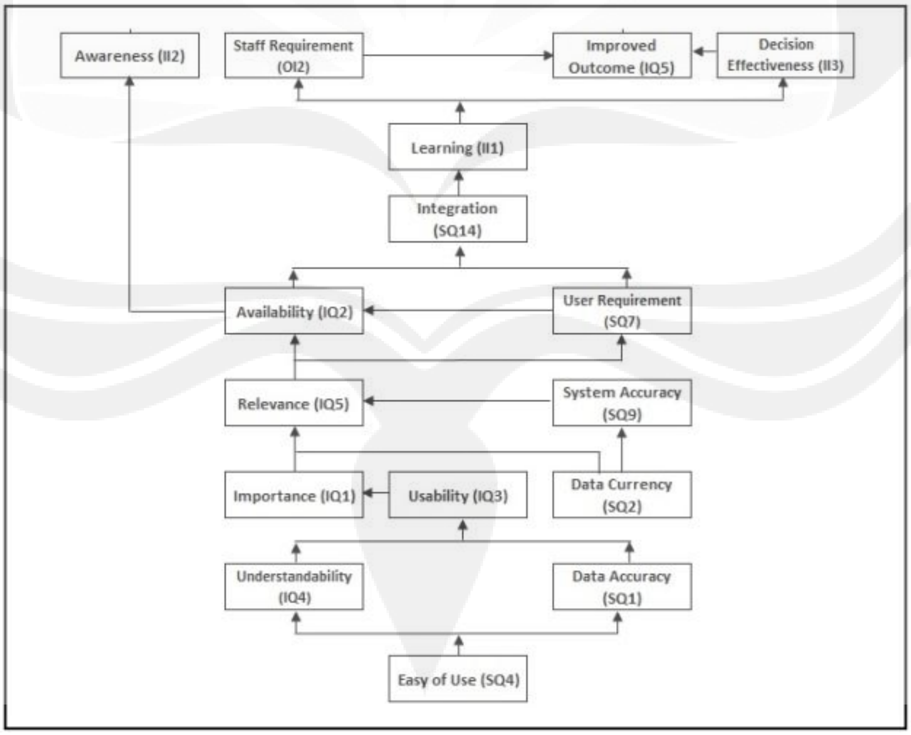

Figure 2.8. Sinaga et al. I/S Success Model of Semi Computerized (Cluster 3)

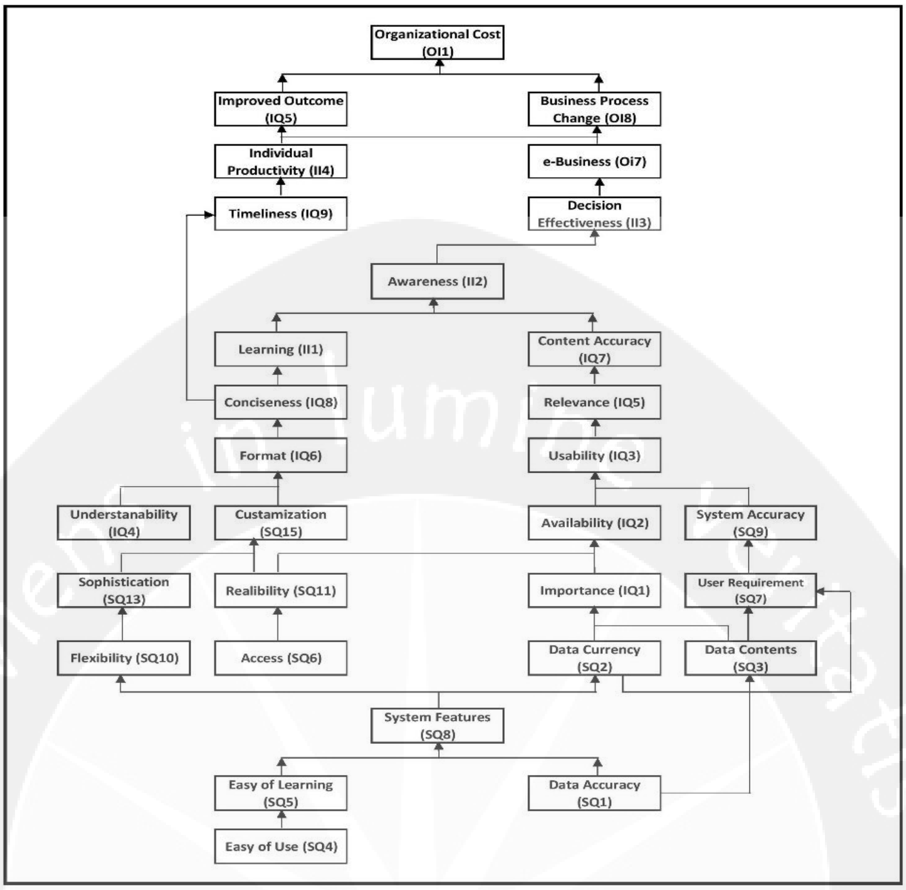

Figure 2.9. Sinaga et al. I/S Success Model of Computerized (Cluster 4)

Another research conducted by Pratama (2016) already test the combined information system model by Sinaga et.al (2015) by using Structural Equation Modelling (SEM) for manual information system in SMEs at Yogyakarta. This study resulted 29 information system criteria for 4 dimensions as follows (Table 2.4.):

Table 2.4. Manual Information System Criteria

No.	Dimension	Criteria
1	System Quality	Data Accuracy
2		Data Currency
3		Database Contents
4		Ease of Use
5		Ease of Learning
6		Access
7		System Features
8		Flexibility
9		Reliability

Table 2.4. Manual Information System Criteria (Continued)

No.	Dimension	Criteria
10	System Quality	Sophistication
11		Integration
12		Customization
13	Information Quality	Availability
14		Understandability
15		Relevance
16		Format
17		Content Accuracy
18		Conciseness
19		Timelines
20		Uniqueness
21	Individual Impact	Learning
22		Decision Effectiveness
23		Individual Productivity
24	Organizational Impact	Organizational Costs
25		Staff Requirements
26		Overall Productivity
27		Improved Outcomes/Outputs
28		E-Business
29		Business Process Change

2.2.3. Decision Making Trial and Evaluation Laboratory (DEMATEL)

DEMATEL is used to establish interrelation or network relationship among organizational dimensions. Many criteria must be considered to evaluate information system implementation decision making. The most common problem is the mutual effects of criteria. Hence, identifying the criteria that has the greatest impact on other criteria prior to the evaluation becomes important, in order to improve the overall performance, as well as the quality and efficiency of the organizational information system (Shih et al., 2013). The DEMATEL was developed between 1972~1976 by the Battelle Memorial Institute for the Science and Human Affairs Program (Shih et al., 2013). Since the DEMATEL methodology can solve issues of complex dependency and provide feasible plans through its hierarchical structure, applications of the methods are extensive, ranging from industrial planning, decision making in production planning, design, and regional environmental evaluation. The DEMATEL is applied to solve the complex dependency issues among criteria. The four steps of method calculation are described as follows (Shih et al., 2013):

a. Step 1: Generate an original impact matrix (A)

The calculations of the original mean matrix are conducted by pairwise comparisons of dimensions (criteria) to evaluate the perceived level of impact of each respondent regarding the dimensions (criteria). The evaluation scale ranges from 0 to 4, where 0 represents no impact among the dimensions (criteria); 1 represents a low level of impact; 2 represents a medium level of impact; 3 represents a high level of impact; and 4 represents an extremely high level of impact as shown in Table 2.5. The original mean impact matrix (A) can be obtained by the average of the summation of the expert answer matrices.

Table 2.5. DEMATEL Scale Range Respondent's Evaluation

Scale	Description
0	No impact between the criteria
1	Low level of impact
2	Medium level of impact
3	High level of impact
4	Extremely high level of impact

b. Calculate the direct impact matrix (M)

First, obtain the maximum values of all rows or columns of the original mean matrix (A), then apply Eq. (1) and (2) to normalize the processes to obtain the direct impact matrix (M); next, conduct priority ranking of the direct impact matrix among dimensions (criteria) by using the summations of the rows and columns of the direct impact matrix (M), where, i and j denote the dimensions (criteria).

$$M = k.A \tag{1}$$

$$k = Min\left(\frac{1}{max_{1\le i\le n}\sum_{j=1}^{n}|a_{ij}|},\frac{1}{max_{1\le j\le n}\sum_{i=1}^{n}|a_{ij}|}\right),\quad i,j = 1,2,3,\ldots,n \tag{2}$$

c. Calculate the total impact matrix (T)

By Eq. (3), the total impact matrix (T) can be obtained.

$$T = M(I-M)^{-1} \tag{3}$$

Next, through Eqs.(4)~(6), obtain the column (element) sum vector (D), and the reverse of the row summation vector (R); then, add up the column sum vectors (D) and the reverse of the row sum vector (R) to obtain the row and column sum vector

(D + R); subtract the column vector (D) and the reverse of the row vector (R) to obtain the row and column difference vector (D－R). When the value of (D + R) is higher, it means that the mutual effects of the dimensions (criteria) are greater. The difference vector (D－R) represents the net impact of the total impact matrix. If (D－R > 0), it means that the dimension (criteria) has greater impact on other dimensions (criteria) than the impact of other dimensions (criteria) on it, hence, it is referred to as the dispatcher. On the contrary, if (D－R < 0), the dimension (criteria) has a smaller impact on other dimensions (criteria) than the impact of other dimensions (criteria) on it, and hence, it is referred to as receiver.

$$T = \left[t_{ij}\right]_{n\times n},\ i, j = 1,2,3, \dots, n \tag{4}$$

$$D = \sum_{j=1}^{n} t_{ij} \tag{5}$$

$$R = \sum_{i=1}^{n} t_{ij} \tag{6}$$

d. Step 4: Structural correlation analysis

After obtaining the total impact matrix, construct the correlation diagram and analyze the impact relations of the value of (D－R) and the value (D + R) by diagram to obtain the structural correlation impact.

2.2.4. Analytical Network Process (ANP)

Professor Thomas L. Saaty wrote module of Analytical Network Process (ANP) in a journal that explains:

> *"The Analytic Hierarchy Process (AHP) is a theory of relative measurement with absolute scales of both tangible and intangible criteria based on the judgment of knowledgeable and expert people. The main concerned of the mathematics of the AHP is how to measure intangibles. The AHP reduces a multidimensional problem into a one dimensional one. Decisions are determined by a single number for the best outcome or by a vector of priorities that gives an ordering of the different possible outcomes. We can also combine our judgments or our final choices obtained from a group when we wish to cooperate to agree on a single outcome.*
>
> *The Analytic Network Process (ANP) is a generalization of the Analytic Hierarchy Process (AHP), by considering the dependence between the elements of the hierarchy. Many decision problems cannot be structured hierarchically because they involve the interaction and dependence of higher-*

level elements in a hierarchy on lower-level elements. Therefore, ANP is represented by a network, rather than a hierarchy.

The Analytical Network Process (ANP) is a general theory of relative measurement used to drive composite priority ratio scales from individual ratio scales that represent relative measurement of the influence of elements that interact with respect to control criteria (Saaty, 1999). ANP is one of the multivariate decision making methods. It's useful when decision makers should consider multiple factors and choices.

The feedback structure does not have the top-to-bottom form of a hierarchy but a network, with cycles connecting its components of elements, which we can no longer call levels, and with loops that connect a component to itself. It also has sources and sinks. A source node is an origin of paths of influence (importance) and never a destination of such paths. A sink node is a destination of paths of influence and never an origin of such paths. A full network can include source nodes; intermediate nodes that fall on paths from source nodes, lie on cycles, or fall on paths to sink nodes; and finally sink nodes. Some networks can contained only source or sink nodes."

The ANP is a coupling of two parts. The first consists of a control hierarchy or network of criteria and sub criteria that control the interactions. The second is a network of influences among the elements and clusters. The network varies from criteria to criteria and a different super matrix of limiting influence is computed for each control criterion. Finally, each of these super matrix is weighted by the priority of its control criterion and the results are synthesized through addition for all the control criteria.

ANP resolves both quantitative and qualitative issues that compare the respondent perceived to cluster and nodes. The judgments are collected in qualitative terms by numerical. The Fundamental Scale used for the judgments is given in Table 2.6. Unlike DEMATEL, matrix of ANP is a geometric matrix in which a comparison of criteria A to B is geometrically of criteria B to A.

Table 2.6. ANP Fundamental Scale

Numerical Scale	Preference Level
1	Equally preferred
2	Equally to moderately preferred
3	Moderately preferred
4	Moderately to strongly preferred
5	Strongly preferred
6	Strongly to very strongly preferred
7	Very strongly preferred
8	Very strongly to extremely preferred
9	Extremely preferred

The vector of priorities is the principal eigenvector of the matrix. This vector gives the relative priority of the criteria measured on a ratio scale. That is, these priorities are unique to within multiplication by a positive constant. However, if one ensures that they sum to one they are then unique and belong to a scale of absolute numbers. Associated with the weights is an inconsistency. The Consistency Index (CI) and Consistency Ratio (CR) of a matrix is given by (7) and (8) (Saaty, 1999).

$$CI = \frac{\mu_{max} - n}{n-1} \tag{7}$$

$$CR = \frac{CI}{RI} \tag{8}$$

The consistency ratio is obtained by forming the ratio of CI (Consistency Index) and the appropriate one of the following set of numbers (RI) as shown in Table 2.7., each of which is an average random consistency index computed for n≤10 for very large samples. They create randomly generated reciprocal matrices using the scale 1/9, 1/8,…,1/2, 1, 2,…, 8, 9 and calculate the average of their eigenvalues. This average is used to form the Random Consistency Index eigenvalues. This average is used to form the Random Consistency Index (RI).

Table 2.7. Random Index (RI)

Order	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

The inconsistency ratio less than 0.1 is desirable, so this is an acceptable level of inconsistency. On a scale from zero to one, the overall inconsistency should be around 10 %.