Applied Mathematics & Information Sciences
An International Journal

http://dx.doi.org/10.12785/amis/090440

Elucidating the Merits of Customer Relationship Management in Cloud Computing

Huan-Ming Chuang[1], *Chien-Ku Lin*[1], *Da-Ren Chen*[2], *You-Shyang Chen*[3,*] *and Li-Chuan Wang*[4]

[1] Department of Information Management, National Yunlin University of Science and Technology, 123, University Rd., Section 3, Douliou, Yunlin 640, Taiwan, R.O.C.
[2] Department of Information Management, National Taichung University of Science and Technology, 129, Section 3, Sanmin Rd., North District, Taichung City 404, Taiwan, R.O.C.
[3] Department of Information Management, Hwa Hsia University of Technology, No. 111, Gongzhuan Rd., Zhonghe District, New Taipei City 235, Taiwan, R.O.C.
[4] Department of Multimedia and Entertainment Science, Asia-Pacific Institute of Creative Technology, 110, XueFu Rd., Toufen, Miaoli 351, Taiwan, R.O.C.

Received: 10 Nov. 2014, Revised: 10 Feb. 2015, Accepted: 11 Feb. 2015
Published online: 1 Jul. 2015

Abstract: Hi-tech companies pursue innovative strategies continuously to enhance their competitive edge in the emerging cloud computing market. As a cloud service model of competitive strategy, Software as a Service (SaaS) strives to foster customer relationship management (CRM). Based on the cloud experience of professional users in CRM for cloud computing, this study elucidates the organizational benefits of CRM in this emerging field. The benefits of enterprise CRM for cloud computing are identified using appropriate qualitative methodologies, including means-end chain (MEC) and interpretive structural modeling (ISM) methods. This study pursues the following three objectives: (1) to help enterprises understand the feasibility of applying cloud computing-based SaaS technology, (2) to explore the enterprise value of CRM services and introduce cloud computing technology to enterprises, and (3) to display the value of an enterprise system more realistically to improve MEC and ISM research methods. Importantly, results of this study significantly contribute to efforts to use the generalized applications of cloud computing in enterprise CRM.

Keywords: cloud CRM, system value, means-end chain (MEC), interpretive structural modeling (ISM)

1 Introduction

The 80/20 principle states that 80% of earned commercial profits originate from the top 20% of customers [1]. A long-term mutually beneficial relationship with customers is essential to business survival and continued growth. Defined as the overall process of building and maintaining profitable customer relationships by delivering superior customer value and satisfaction [2], customer relationship management (CRM) has received widespread recognition from academics and practitioners.

Cloud computing is gradually creating a shift in which firms move from a fixed computing infrastructure to a more flexible one; firms own some strategic parts, while computer hardware vendors own some less-critical parts rented from giant computer centers [3]. Cusumano [4] posited that cloud computing and the Software as a Service (SaaS) deployment model have clearly become a new commercial platform. The increasing popularity of cloud computing explains why many enterprise resource planning (ERP) systems vendors are planning to move into this area. Software vendors operate SaaS to deploy their software on a virtual platform with powerful distributed computing capabilities generally owned by cloud computing platform providers, such as Microsoft, IBM, and Google, with data centers worldwide.

Given the importance of CRM, SaaS CRM (commonly referred to as cloud CRM) is one of the most-widely used SaaS software offerings. As one of the most influential multinational companies in this area, Salesforce.com has generated $US 500 million in assets and $US 50 billion market value with its CRM software. In addition to Salesforce.com, other renowned cloud CRM vendors include Microsoft Dynamics CRM (in

* Corresponding author e-mail: ys_chen@cc.hwh.edu.tw

collaboration with Chunghwa Telecom for its Taiwan operations), NetSuite, and sageCRM.com [5]. SaaS applications enable various-sized organizations to test and adopt new software applications efficiently [6]. This study attempts to identify major perceived benefits of cloud CRM users. Based on the above discussion, this study has the following objectives:

(1) identify major potential benefits produced by cloud CRM-related applications;
(2) construct mental models with respect to the identification of cloud CRM-related benefits; and
(3) provide guidance in successfully implementing cloud CRM.

2 Literature Review

This section introduces relevant literature, including sustainable customer relationship management, cloud computing, cloud CRM, and the building blocks of competitive advantage.

2.1 Customer relationship management

Possibly the most important concept of modern marketing [7], customer relationship management (CRM) nurtures and maintains mutually beneficial customer relations by delivering customer value and satisfaction. CRM encompasses all aspects of acquiring, retaining, and increasing the number of customers.

Several CRM practices have been identified (i.e., strategic, operational, analytical, and collaborative), as summarized in Table 1. Strategic CRM fosters a customer-driven business culture by acquiring and retaining profitable customers through the establishment and maintenance of mutually beneficial relationships. By automating and improving customer relations and customer support, operational CRM includes marketing automation, sales-force automation, and service automation. Analytical CRM gathers, stores, mines, and reports customer-related data to enhance both customer and company value. Finally, collaborative CRM refers to the strategic and tactical alignment of normally independent enterprises in a supply chain to create additional value for customers and supply chain members.

Some representative definitions can be described as follows [8]:

(1) As an information industry term for methodologies, software, and Internet capabilities, CRM helps an enterprise manage customer relationships methodically.
(2) CRM manages all interactions that a company has with its customers, including prospective contacts, sales, and service. CRM also provides further insight into company-customer relationships by integrating all perspectives on customer interactions.
(3) CRM identifies, acquires, and retains customers. By enabling organizations to manage and coordinate customer interactions across multiple channels, departments, lines of business, and geographical areas, CRM helps organizations maximize the value of every customer interaction and ensure superior corporate performance.
(4) As an integrated information system that plans, schedules and controls pre-sales and post-sales activities in an organization. CRM encompasses all aspects of handling prospective and actual customers, including the call center, sales force, marketing, technical support and field services. While focusing on increasing long-term growth and profitability through a more thorough understanding of customer behavior, CRM provides more-effective feedback and enhanced integration to gauge more accurately the return on investment (ROI) in these areas.
(5) As a business strategy, CRM maximizes profitability, revenue and customer satisfaction by organizing customer segments, fostering customer satisfaction, and implementing customer-oriented processes.

Table 1: CRM Practices

CRM Type	Major feature
Strategic	This customer-driven business strategy concentrates on acquiring and retaining profitable customers.
Operational	This management practice focuses on streamlining customer relations and support, including selling, marketing, and customer service.
Analytical	This type focuses on mining customer-related data for strategic or tactical purposes.
Collaborative	This management practice applies technologies across the organizational structure to optimize company, partner, and customer value.

2.2 Cloud computing

Cloud computing allows firms and individuals to obtain resources and software applications over the Internet (i.e., the cloud) [3]. The National Institute of Standards and Technology (NIST) of the U.S. Department of Commerce formally defines cloud computing as a model for enabling ubiquitous, convenient, on-demand, network access to a shared pool of configurable computing resources (i.e., networks, servers, storage, applications, and services) that can be provided and released rapidly with minimal management effort or service provider interaction. Despite its significantly lower infrastructure costs, cloud computing is limited by concerns over privacy, security, and reliability [3,9]. Due to its practical merits, cloud computing has been widely applied in fields such as

information retrieval [10,11,12], security [13,14,15,16], energy consumption [17], resource management [18,19], cloud storage services [20], privacy [21], image retrieval [22], network caching [23], and cloud storage systems [24].

A model of cloud computing consists of five essential features, three service models, and four deployment models [25]. This model is based on the postulates of Mell and Grance [25], Tables 2, 3, 4 list the essential characteristics, service models, and deployment models.

Table 2: Essential features of cloud computing

Feature	Description
On-demand self-service	Consumers can obtain computing capabilities, including resources (i.e., storage, processing, memory, and network bandwidth) and applications, over the Internet as needed automatically without the service provider intervening.
Broad network access	Computing capabilities are available over the Internet and can be accessed through a standard mechanism that facilitates use by various platforms (e.g., mobile phones, tablets, laptop computers, and workstations).
Resource pooling	Computing resources of service providers are accumulated to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned based on consumer needs. Consumers are generally unaware of the exact location of the provided resources.
Rapid elasticity	Computing capabilities can be elastically provided automatically to satisfy consumer requirements. Available capabilities appear unlimited to consumers and can be used in any quantity and at any time.
Measured service	Cloud computing is operated as utility computing under a pay-per-use basis. While transparent to both providers and users, computing resources can be monitored, controlled, and reported.

2.3 Cloud CRM

Carr [26] asserted that cloud computing represents a transformation of how corporations perform computing, as evidenced by the shift in business computing from a private data center into "the cloud." Despite a lack of actual implementations, cloud computing appeals more to small and medium-sized businesses that lack the resources to invest and own their own hardware and software. According to the top 40 CRM software vendors rated by business-software.com, Microsoft Dynamics and Salesforce.com are the leading two cloud CRM software offerings available in Taiwan for small and medium-sized

Table 3: Service models of cloud computing

Service model	Description
Software as a Service (SaaS)	Customers use software hosted by service providers. Users access these applications from a Web browser, and the data and software are maintained on providers' remote servers.
Platform as a Service (PaaS)	Customers use infrastructure and programming tools hosted by service providers to develop their own applications. Customers do not manage or control the underlying cloud infrastructure (i.e., network, servers, operating systems, or storage), yet have control over the deployed applications and possible configuration settings for an application-hosting environment.
Infrastructure as a Service (IaaS)	Customers use processing, storage, networking, and other computing resources from cloud service providers to operate their information systems. Customers do not manage or control the underlying cloud infrastructure, yet have control over operating systems, storage, and deployed applications and possibly limited control of selected networking components, such as host firewalls.

Table 4: Deployment models of cloud computing

Deployment model	Description
Private cloud	A cloud infrastructure is exclusively used by a single organization with multiple business units. The infrastructure may be owned, managed, and operated by the organization, a third party, or a combination of these, and it may exist on or off premises.
Community cloud	A cloud infrastructure is exclusively used by a specific community of consumers from organizations that have shared goals. The infrastructure may be owned, managed, and operated by one or more organizations in the community, a third party, or a combination of these, and it may exist on or off premises.
Public cloud	A cloud infrastructure is accessible to the public. The infrastructure may be owned, managed, and operated by a business, academic, or governmental organization, or a combination of these, and it is owned and operated by a cloud provider.
Hybrid cloud	A cloud infrastructure consisting of two or more deployment models that remain unique entities, yet are bound together by standardized or proprietary technology that allows for data and application portability.

businesses. Their essential features are described briefly as follows.

First, Microsoft Dynamics CRM offers three service categories: (1) sales solutions: Establish a 360-degree perspective on customer interaction and sales opportunities; (2) marketing solutions: Plan, implement, and devise more-effective marketing campaigns; and (3) customer service solutions: Deliver value with integrated interaction and knowledge management.

Second, Salesforce CRM provides similar services: (1) sales cloud for sales and marketing: For sales managers, CRM cloud applications provide real-time visibility into their team activities, allowing them to forecast sales confidently. For sales representatives, CRM cloud applications simplify management of customer information, allowing representatives to spend less time handling data and more time serving their customers. For marketing managers, CRM cloud applications can inform all conversations on a social network with the internal knowledge that agents use daily to increase customer responsiveness cost-effectively. (2) service cloud for customer service: Able to empower social media to work for businesses, a service cloud helps to transform customer service and amaze those customers by socially interacting with them.

2.4 Building blocks of a competitive advantage

According to Jones and Hill [27], four critical factors can be viewed as the building blocks of a company's sustainable competitive advantage: superior efficiency, quality, innovation, and customer responsiveness. Each factor is the product of a company's distinctive competencies, which were shaped by leveraging their resources and capabilities (Fig. 1).

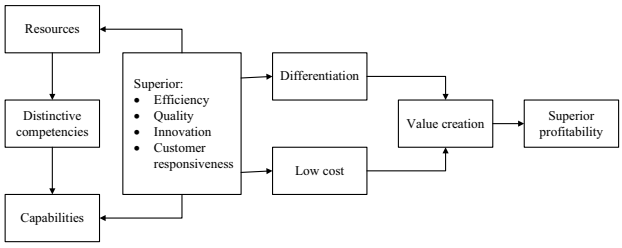

Fig. 1: Origins of competitive advantage.

Despite a brief discussion of them below, the four factors are closely related to each other. For instance, successful innovation might increase efficiency, quality, and customer responsiveness, and superior quality might lead to customer responsiveness. Efficiency can be calculated based on the quantity of inputs that it takes to produce a given output. Therefore, a more efficient company implies that a lower quantity of inputs is required to produce a particular output, or the same number of inputs to produce yet more output. A product is assumed to be of superior quality when a customer perceives that its attributes (e.g., form, features, performance, style, and durability) provide more flexibility than do the attributes of alternative products. Customer evaluation of product quality involves two significant sub-dimensions. Quality as excellence emphasizes important product attributes such as a product's design and styling, its appealing aesthetics, its features and functions, the service provided, and similar attributes. As for quality as reliability, a product can be assumed reliable when it consistently performs well the function for which it was designed, with minimal possibility of breakdowns. Product reliability, as with product excellence, increases the benefits that consumers receive from a product; the company thus has more flexibility in product price and higher potential for profitability. Innovation involves creating new products (i.e., product innovation) or processes (i.e., process innovation). Product innovation refers to the development of products that are superior to current ones. Product innovation creates value by providing more utility to consumers, allowing a company to charge premium prices. Process innovation refers to an innovative means of producing and distributing products. Process innovation often allows a company to lower production costs to create value. Both innovations are vital to competition because competition is largely a process driven by innovations. Customer responsiveness implies that a company can perform better than can competitors in identifying and satisfying its customers' needs. Customers who are better served attribute more utility to the products they have consumed, creating a differentiation strategy based on a competitive edge. To improve customer responsiveness, companies generally customize their goods or services to the unique demands of individual customers or customer groups. Another effective means to enhance customer responsiveness is to shorten customer service response time, i.e., the time required for product or service delivery.

3 Research Methodology

This section briefly introduces the research framework and research methodology of this study.

3.1 Research framework

While attempting to gain insight from experienced users of cloud CRM, this study applies appropriate qualitative methodologies (e.g., means-end chain (MEC) and interpretive structural modeling (ISM)) to identify the merits of cloud CRM. Based on an exhaustive literature review, this study proposes the following research framework (Fig. 2):

Table 5: Abstract and recognition levels of the means-end chain

Abstract levels	Personal cognition	Values	Terminal values
			Instrumental Values
↑		Consequences	Psychological consequences
	Product cognition		Functional consequences
Concrete levels		Attribute	Abstract attributes
			Concrete attributes

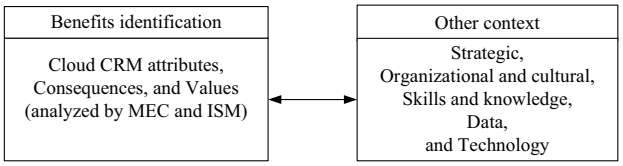

Fig. 2: Research framework of this study.

3.2 Research methodology

The research methodology of this study includes the means-end theory, laddering approach, Pareto protocol, and interpretive structural modeling approach.

3.2.1 Means-End theory

The means-end theory postulates that customer evaluation of a product can be represented by a hierarchical model of three interconnected levels: product attributes, consequences of use and personal values [28,29]. In particular, attributes are concrete (e.g., shape) or abstract (e.g., fashion) product characteristics; consequences are perceived results of consumption of the product; and values can be perceived as instrumental or terminal benefits of consumers [30]. The means-end theory assumes that consumers view products as a means to important ends and attempts to explain how product or service selection can help to achieve the desired end-states [31]. A higher hierarchical level generally implies a greater level of abstraction [32]. Table 5 summarizes the MEC concepts [30,33].

The MEC model of Gutman [30] posits that values dominate the purchasing behavior of consumers. Specifically, consumers consider products or services based on the function of satisfying values, which are shaped by desired consequences that are connected with product or service attributes. The MEC model is thus based on the attribute-consequence-value (A-C-V) sequence with a structure that connects product or service attributes to consequences produced and finally to values [29].

3.2.2 Laddering approach

The laddering approach is the conventional means of undertaking MEC analysis [29,33,34,35]. This approach refers to an in-depth one-on-one interviewing method to explore how consumers translate product attributes into meaningful associations with themselves [29,30,36]. Laddering involves a tailored interviewing format using mainly a series of questions such as "Why is that important to you?" to further elucidate the linkage correlations between the key elements of A-C-V (i.e., a ladder). Figure 3 shows the laddering procedure.

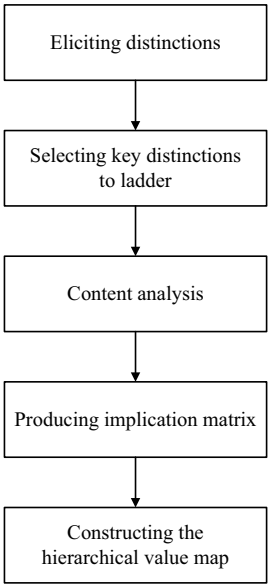

Fig. 3: Laddering approach.

3.2.3 Pareto principle

The "80-20 rule" states that 20% of all products contribute to approximately 80% of organizational profits. As is generally assumed, 20% of the variables in a system account for the majority (80%) of the total variation in the system (e.g., output or profit). A highly effective means of determining the critical minor variables is based on the Pareto protocol [37], which is promoted among management and systems theorists such as Juran [38]. The Pareto Principle applies a "Min Max criterion" to optimize a tradeoff between two criteria. Restated, final results account for maximum variation in the system while minimizing the number of variables for the sake of parsimony. This principle can solve the inevitable problems of disagreement and ambiguity between either individuals or subgroups regarding the nature of the system studied.

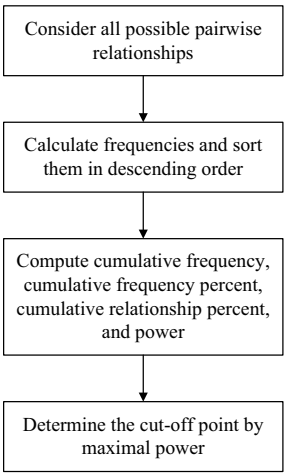

Fig. 4: Steps in the Pareto protocol.

Figure 4 shows the steps in the Pareto protocol, as summarized in the following:

(1) Consider all possible pairwise relationships. Assume that the system has n variables. The combinatorial expression $n!/r!(n-r)!$ then represents the total number of variables; in addition, r always equals 2.
(2) Calculate the frequencies of all relationships and then sort them in descending order.
(3) Calculate the following numbers:
   (a) Cumulative frequency (CF): Entries in this column contain the running total frequency.
   (b) Cumulative frequency percent (CFP): Each entry represents the percentage of votes cast for a variable pair added to the previous total.
   (c) Cumulative relationship percent (CRP): This is a cumulative percentage based on the number of all possible relationships (i.e., $1/n$, where n denotes the total possible relationships).
   (d) Power: Power refers to the difference between CFP and CRP, as an index showing the degree of optimization of the system.
(4) Determine the cut-off threshold: According to the MinMax criterion, the cut-off point is determined by the frequency with maximal power. Here, Max refers to the maximum total variations explained and Min to the minimum frequency required.

3.2.4 ISM approach

Pioneered by Warfield [39,40], interpretive structural modeling (ISM) analyzes complex socioeconomic systems. ISM helps individuals or groups structure their domain knowledge into a model of interrelationships to enhance their understanding of a given complexity. The results of the ISM process are generally represented by a graph that displays the directed relationships as well as hierarchical levels of elements within a system under consideration. ISM has been widely applied in various fields such as sustainable ecotourism [41], solar power [42], and risk analysis [43]. Figure 5 illustrates the steps in the ISM process, as described in the following:

(1) Identification of elements: Elements of this system are identified and listed. This can be achieved through research (e.g., literature review) or expert opinion (e.g., Delphi or brainstorming);
(2) Specification of contextual relationship: A contextual relationship between elements is established, depending on the objective and nature of the case;
(3) Construction of a structural self-interaction matrix (SSIM): This matrix represents the pairwise relationships among the elements. Four possible relationships between the elements (a & b) can be denoted as follows.
   $\rightarrow$: for the relationship from a to b, yet not in the reverse direction;
   $\leftarrow$: for the relationship from b to a, yet not in the reverse direction;
   $\leftrightarrow$: for an interrelationship between a and b (both directions);
   X: to represent that a and b are unrelated;
(4) Transformation of the SSIM into an initial reachability matrix (RM): an RM is then prepared that converts the symbolic SSIM into a binary matrix. Rules for the substitution of 1's and 0's are as follows.
   If a $\rightarrow$ b, then a $\rightarrow$ b entry becomes 1, b $\leftarrow$ a entry becomes 0.
   If a $\leftarrow$ b, then a $\rightarrow$ b entry becomes 0, b $\leftarrow$ a entry becomes 1.
   If a $\leftrightarrow$ b, then a $\rightarrow$ b entry becomes 1, b $\leftarrow$ a entry becomes 1.
   If a and b both are not related to each other, then a $\rightarrow$ b entry becomes 0, b $\leftarrow$ a entry becomes 0, and (a, a) and (b, b) entries are set to 1;
(5) Verification of the initial RM for transitivity: Transitivity of the contextual relationship is a basic assumption made in ISM. This assumption states that if element A is related to B and B is related C, then A must be related to C. The final RM (M*) is obtained by successively calculating the power of the initial RM (M) until $M^k = M^{k-1}$, where k denotes the power of M. Based on M*, the driving power and dependence of each element can also be calculated. Driving power of a particular element is the total number of elements (including itself) that may be achievable. Dependence denotes the total number of elements (including itself) that may help in achieving it;
(6) Partitioning of the levels of the final RM: According to the final RM, the reachability and antecedent sets for each element are found. The reachability set consists of the element itself and the other elements that it may help to achieve, whereas the antecedent set consists of the element itself and the other elements that may help in achieving it. Therefore, the intersection of these sets is derived for all of the elements. Elements for which the reachability and

intersection sets are the same occupy the top level in the ISM hierarchy. The top-level element in the hierarchy does not help achieve any other element above its own level. Once identified, the top-level element is separated out from the other elements. The same process is repeated to identify the elements in the next level. This process is continued until the level of each element is found; and

(7) Construction of the ISM digraph and model: A digraph is a graphical representation of the elements, their directed relationships, and hierarchical levels. It can be prepared based on identified levels and the final RM. The ISM is generated by replacing all element numbers with corresponding actual element descriptions. Finally, ISM clearly illustrates the relationships among systems of elements.

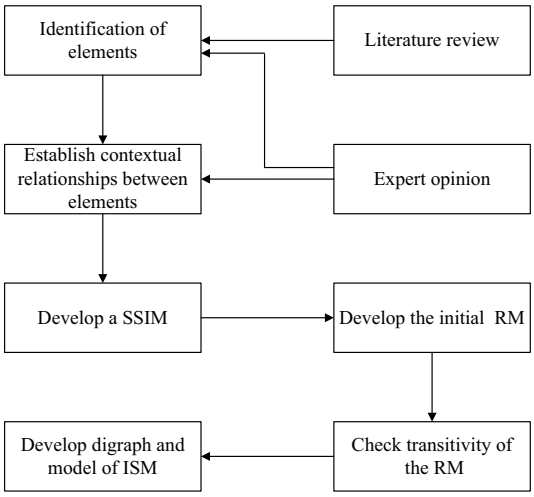

Fig. 5: Flow diagram for preparing ISM.

4 Identifying the benefits of cloud CRM

Based on MEC analysis, this study investigates the benefits of the identification model of cloud CRM and presents a data analysis. Figure 6 summarizes the results of the procedure described below.

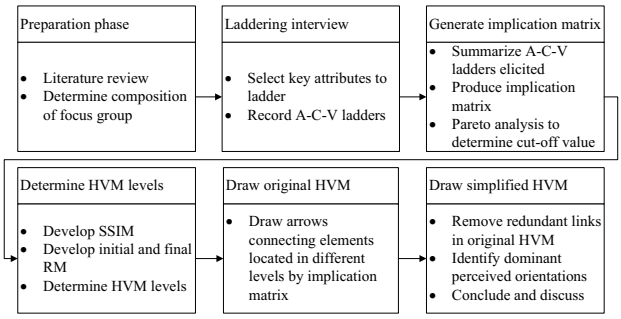

Fig. 6: Benefits identification analysis.

4.1 Sampling and sample profiles

Grunert and Grunert [34] suggested the subject of laddering interviews chosen here and that researchers should accumulate ladders from a group of homogeneous respondents including software vendors and IS professionals with wealth experiences with cloud CRM in common. The number of conducted interviews was theory driven because qualitative research should always consider whether to accumulate more data following the principle of theoretical saturation. Restated, researchers should sample respondents until they believe that the information they gather achieves theoretical saturation. Theoretical saturation implies that no new or relevant data emerge concerning a category, that the category is well developed and that the linkage between categories is well-established [44].

Based on the theoretical saturation principle, this study interviewed 30 subjects. Table 6 lists their profiles. Means-end data, which consisted of a four-step series [28, 29, 35, 45], is analyzed as follows:

Table 6: Demographic data of the sample

Category	Items	Frequency	Percentage	Total
Software used	Salesforce CRM	13	43%	30
	Microsoft Dynamics CRM	14	47%	
	vTiger CRM	3	10%	
Gender	Male	18	60%	30
	Female	12	43%	
Age	30 and below	9	30%	30
	31–40	10	33%	
	41–50	9	30%	
	51 and above	2	7%	
Education	High school and below	0	0%	30
	College	5	17%	
	University	14	46%	
	Master's degree	8	27%	
	Doctorate	3	10%	
Title	IS staff	1	3%	30
	Marketing staff	15	50%	
	Marketing manager	7	23%	
	CIO	2	7%	
	CRM manager	5	17%	
IS or marketing experiences	5 and below	13	43%	30
	6–10	12	40%	
	11–15	1	3%	
	16–20	2	7%	
	21 and above	1	3%	
Cloud CRM experiences	1 and below	12	40%	30
	2–3	10	33%	
	4–5	8	27%	

Table 7: Attribute codes and description

Code	Category	Description
A1	On-demand self-service	Computing capabilities are provided as deemed necessary without human intervention.
A2	Broad network access	Services are made available through mobile devices online.
A3	Resource pooling	Computing resources are pooled to serve multiple uses.
A4	Measured service	Pay-per-use model of charges.
A5	Customer contact person management	Comprehensive management of customers, prospects, and contact persons' information.
A6	Schedule management	Planning and coordinating activities of marketing staff.
A7	Campaign management	Planning, implementing, and control of marketing promotion activities.
A8	Sales management	Planning and control of sales-related activities.
A9	Knowledge management	Acquisition, storage, and application of knowledge from cloud CRM.
A10	Service case management	Critical service cases are managed to improve service quality.
A11	Analytics/ reporting engine	Results mined from customer data are analyzed and reported.
A12	Customized work flow	Convenient customization for important workflows is provided.
A13	Customized system interface	The interface of a cloud CRM system is easily customized without the intervention of consultants.
A14	Instant full text search	Useful full text searches by keywords are performed.
A15	Off-line functions	Off-line processing capabilities are supported.
A16	Open-source interface platform	The interface platform is open-source enabled.
A17	CRM community platform	A community platform for the interaction of customers and the company is provided.

Table 8: Consequence codes and description

Code	Category	Description
C1	Efficiency	Producing additional outputs with the same inputs or the same outputs with fewer inputs.
C2	Quality as excellence	Having products or services with outstanding features.
C3	Quality as reliability	Having products or services with stable performance.
C4	Innovation	Having improved new products or processes.
C5	Customer responsiveness	Understanding customers' needs and capable of providing customized services.
C6	Learning and growth	Acquiring knowledge and improvements from cloud CRM usage.
C7	Service flexibility	Offering services with elasticity.
C8	Process improvements	Creating a process efficiently and effectively.

(1) Perform content analysis of the interviews and codification of the identical elements.
(2) Generate an implication matrix by quantifying existing relationships between elements.
(3) Construct a hierarchical value map.
(4) Determine dominant perceptual orientations.

4.2 Conducting content analysis

Content analysis was performed by extracting accumulated rough data from the interviews to identify concepts related to attributes, consequences, and values. The next step identified key elements. Tables 7, 8, 9 summarize the results.

Table 9: Value codes and description

Code	Category	Description
V1	Differentiation advantage	Advantage created by offering unique products or services.
V2	Low cost advantage	Advantage created from a lower cost structure in industry.

Three domain experts were involved in the content analysis to satisfy the requirements of triangulation. Intercoder reliability broadly refers to how independent coders evaluate an attribute of a message or artifact and reach the same conclusion [46]. Intercoder reliability of this study is calculated based on the suggestion of Holsti [47] by employing the following formula: agreements/(disagreements + agreements). Table 10 summarizes those results, which fulfill the suggested minimum criterion of 0.8 [47,48].

4.3 Generating the implication matrix

The second step of the analysis, i.e., the generation of the implication matrix, represents the number of times that each element leads to another that is on a ladder in which an element proceeds another [29]. The number of relationships is presented systematically in a fractional form, where the direct relationships appear to the left of the decimal point and indirect relationships to the right.

Table 10: Intercoder reliability of this study

Coder	Total items coded	Intercoder disagreement			Intercoder agreement	
		A	B	C	A	B	C
A	409		13	19	(2*396)/(409 + 396) = 0.98	(2*390)/(409 + 390) = 0.98
B	396			12	(2*387)/(396 + 390) = 0.98	
C	390					

Note: Average intercoder agreement = (0.98 + 0.98 + 0.98)/3 = 0.98
Intercoder reliability = (Number of coders * average intercoder agreement)/(1 + (Number of coders − 1) * average intercoder agreement) = $(3*0.98)/(1+(3-1)*0.98) = 0.99$

4.4 Constructing the uncluttered HVM

HVM represents an aggregated group mental model based on complex and interacting personal phenomena; the original diagram containing all links between elements could be cluttered in nature. The problem with saturated links is that the cluttered diagrams, while comprehensive and wealthy in meaning, can be extremely difficult to interpret. Restated, cluttered diagrams might lead to noting only the details rather than the overall picture. Obviously, a tradeoff between richness and parsimony is necessary. Such a tradeoff is possible by producing a secondary uncluttered diagram with the redundant links removed. Figure 7 illustrates the main notion of this treatment, as described below.

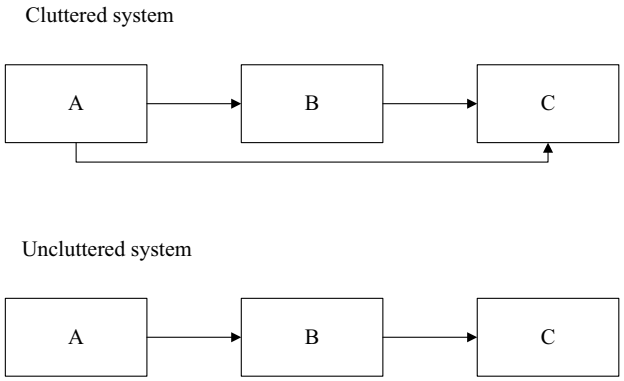

Fig. 7: Cluttered system and uncluttered system.

The cluttered system represents the perception of an individual who A influences B, B influences C, and A influences C. This system can be simplified to become uncluttered by removing the link from A to C. This link is redundant because it can be explained by link A to B plus link B to C. Obviously, the possibility that A does indeed influence C directly and significantly cannot be denied. However, without B, explaining this link is rather difficult. Thus, removing links that skip over mediating elements allows us to create a simpler, more interpretable mental model. Based on this principle, Figure 8 shows an uncluttered HVM.

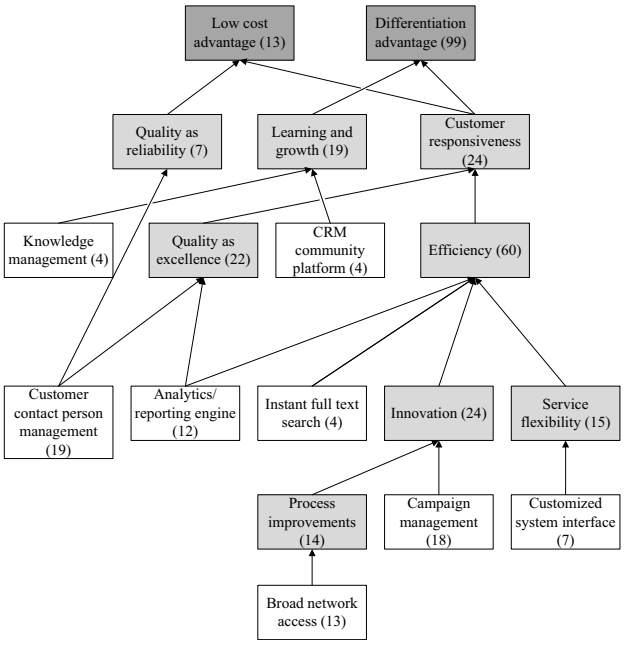

Fig. 8: Uncluttered hierarchical value map.

Note: white boxes represent attributes; light gray boxes represent the consequences; dark gray boxes denote the values; and numbers in parentheses refer to occurrence.

4.5 Determining dominant perceptual orientations

Dominant perceptual orientations are determined by analyzing two sub-steps: determining driving power and dependence, and analyzing dominant links.

4.5.1 Determining driving power and dependence

For the 18 elements identified in HVM, this study more closely examines their dominant perceptual orientations by studying their cause-effect features. Salimifard, Abbaszadeh, and Ghorbanpur [49] designed a driving power-dependence diagram to help classify various decision factors into four clusters (Fig. 9). The cluster in quadrant I includes “linkage” elements with strong

driving power and dependence. This finding suggests that all of the factors above this level are affected by these elements; these elements also depend on lower-level factors of the ISM model. The cluster in quadrant II consists of the dependent factors with weak driving power yet strong dependence. Factors in this cluster are the most important and influential ones. The cluster in quadrant III includes "autonomous" factors with weak driving power and weak dependence. These factors are relatively disconnected from the system. Finally, the cluster in quadrant IV includes "dependent" factors with weak driving power yet strong dependence. These factors are generally representative of desired system outcomes.

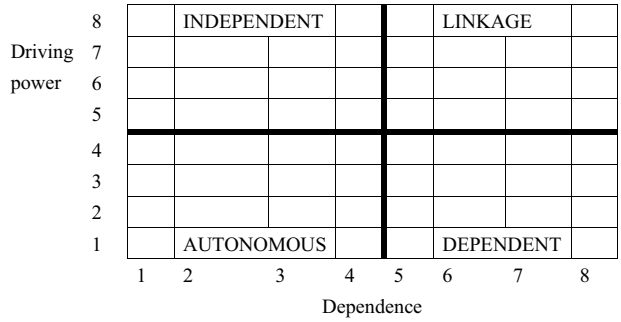

Fig. 9: Positions of driving power and dependence.

In the final reachability matrix, the driving power and dependence of each element can be further computed. Driving power of a particular element refers to the total number of elements (including itself) that it may help to achieve. Conversely, dependence is the total number of elements that may help to achieve it (Fig. 10).

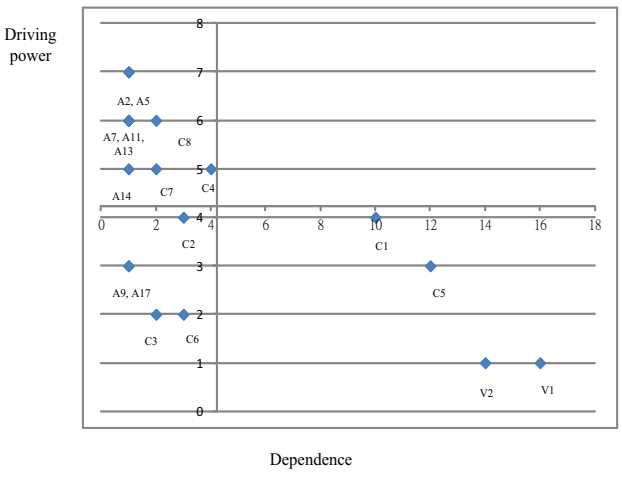

Fig. 10: Driving power-dependence diagram.

4.5.2 Analyzing dominant links

Based on the elements in HVM, two major links can be identified, as shown in Figure 11 and summarized in Table 11.

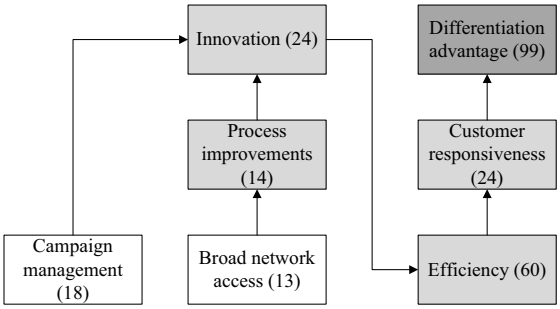

Fig. 11: Dominant HVM links.

5 Findings and Managerial Implications

Results of this study and management implications for cloud CRM services provide a valuable reference for both academics and practitioners, as summarized in the following.

5.1 Hierarchical value map

Thirty participants experienced with cloud CRM identified eight attributes, eight consequences, and two values. Based on the final mental model (HVM) constructed, the most important perceived cloud CRM attributes are "customer contact person management," "campaign management," "broad network access," "analytics/reporting engine," "customized system interface," "knowledge management," "CRM community platform," and "instant full text search." Important perceived cloud CRM consequences include "efficiency," "innovation," "customer responsiveness," "quality as excellence," "learning and growth," "service flexibility," "process improvements," and "quality as reliability." Finally, the "differentiation advantage" created by cloud CRM is much more highly expected than the counterpart of "low cost advantage."

5.2 Managerial implications of HVM

By integrating system elements and their relationships, this study can identify two important ladders. The first is from "campaign management" → "innovation" → "efficiency" → "customer responsiveness," and finally to "differentiation advantage." The second starts from "broad network access" → "process improvements" →

Table 11: Dominant links and related verbatim

Links	Representative verbatim
Campaign management (A7) → Innovation (C4)	C18-FDC-CE1: The monthly free short message quota offering can be used to send a notification before being displayed through a cell phone rather than traditional postage mail (it is new to our processes).
Broad network access (A2) → Process improvements (C8)	S05-MCE-CA1: Broad network access is highly useful for businesses, in which the cross-platform feature (customer-facing) processes can be significantly improved.
Process improvements (C8) → Innovation (C4)	S08-FCB-AA1A: With mobile devices such as the iPad, the customer address map can be easily searched, followed by scheduling of the optimal visiting routes online for sale representatives' productivity, which can be greatly enhanced.
Innovation (C4) → Efficiency (C1)	C18-FDC-CE1: The innovative process of sending exhibit notification through a cell phone streamlines the management efficiency of potential customers.
Efficiency (C1) → Customer responsiveness (C5)	C22-MDE-CA6: Cloud CRM stores all information related to prospective customers; comprehensive and systematic tracking can be easily performed, leading to frequent and quality interaction with customers that can enhance customer responsiveness dramatically.
Customer responsiveness (C5) → Differentiation advantage (V1)	S12-MBD-AA2: Cloud CRM can help managers to more clearly understand customer needs. Providing customized services allows customers to recognize and support service providers. Consequently, companies can achieve a sustainable (differentiation) advantage.

"innovation", then follows the same path to reach "differentiation advantage." Major implications of this finding for cloud CRM service providers are that functions related to "campaign management" and "broad network access" can be heavily emphasized and promoted. Meanwhile, from the perspective of cloud CRM users, to pursue a successful differentiation advantage, "process improvements," "innovation," "efficiency," and "customer responsiveness" must be given greater attention. Moreover, the dynamics among the consequence elements indicate interactions among four building blocks of sustainable competitive advantage.

6 Conclusions

This study demonstrates that the ISM concepts of reachability and antecedent set as well as related matrix operations are a promising alternative for the task of system rationalization. In particular, the notion of level partition functions in a role similar to divide and conquer. This can help to create an uncluttered system efficiently and effectively. The benefits of the ISM algorithm are even more significant in constructing HVM during MEC analysis, whereas most current approaches are guided by a heuristic in which external validity and visual interpretations are difficult to achieve.

Despite its contributions, this study has certain limitations. The focus group participants in this study are mainly from small and medium-sized manufacturers in the electronic and information industry, which does not include the service industry. Future research should focus on models for the service industry. Additionally, although this study carefully screened and organized domain expert panels with rich experiences in cloud CRM, future research should conduct a large sample survey and use structural equation modeling (SEM) analysis to cross-validate the research results. Furthermore, multi-criteria decision-making schemes, including analytical network process (ANP) and the DEMATEL-based ANP, can be applied to obtain responses with greater detail and insight.

References

[1] W. A. Sherden, Market ownership: the art & science of becoming# 1, New York: American Management Association, 1994.
[2] P. Kotler and G. Armstrong, Principles of Marketing, 9th edition. Englewood Cliffs, Prentice-Hall Inc, NJ, 2008.
[3] K. C. Laudon and J. P. Laudon, Essentials of management information systems, Upper Saddle River: Pearson, 2011.
[4] M. Cusumano, Technology strategy and management cloud computing and SaaS as new computing platforms, Communications of the ACM **53**, 27-29 (2010).
[5] A. DeFelice and J. C. Leon, Cloud computing what accountants need to know, Journal of Accountancy **210**, 50 (2010).
[6] J. M. Kaplan, Saas: Friend or for, Business Communications Review **37**, 48-53 (2007).
[7] G. Armstrong and P. Kotler, Principles of Marketing, Pearson College Div, 2011.
[8] F. Buttle, Customer relationship management concepts and technologies, Routledge, 2009.
[9] R. K. Rainer and C. G. Cegielski, Introduction to information systems: Enabling and transforming business, John Wiley & Sons, 2010.
[10] G. Chowdhury, How digital information services can reduce greenhouse gas emissions, Online Information Review **36**, 489-506 (2012).
[11] B. I. Judit, Z. G. Maayan, M. Yitzchak and S. Snunith, Tag-based retrieval of images through different interfaces: a user study, Online Information Review **36**, 739-757 (2012).

[12] C. Hung, C. F. Tsai, S. Y. Hung and C. J. Ku, OGIR: an ontology-based grid information retrieval framework, Online Information Review **36**, 807-827 (2012).
[13] L. M. Vaquero, L. Rodero-Merino and D. Morán, Locking the sky: a survey on IaaS cloud security, Computing **91**, 93-118 (2011).
[14] Z. Pervez, A. M. Khattak, S. Lee, Y. K. Lee and E. N. Huh, Oblivious access control policies for cloud based data sharing systems, Computing **94**, 915-938 (2012).
[15] C. Wang, S. S. M. Chow, Q. Wang, K. Ren, Privacy-Preserving Public Auditing for Secure Cloud Storage, **62**, 362-375 (2013).
[16] M. Mobini, Z. Mobini, M. Rabbani, An Artificial Immune Algorithm for the project scheduling problem under resource constraints, Applied Soft Computing, **11**, 1975-1982 (2011).
[17] J. Song, T. Li, Z. Wang and Z. Zhu, Study on energy-consumption regularities of cloud computing systems by a novel evaluation model, Computing, **95**, 269-287 (2013).
[18] S. Islam, J. Keung, K. Lee, A. Liu, Empirical prediction models for adaptive resource provisioning in the cloud, Future Generation Computer Systems, **28**, 155-162 (2012).
[19] S. Subashini, V. Kavitha, A survey on security issues in service delivery models of cloud computing, Journal of network and computer applications, **34**, 1-11 (2011).
[20] C. Wang, Q. Wang, K. Ren, N. Cao, Toward Secure and Dependable Storage Services in Cloud Computing, Services Computing, IEEE Transactions on, **5**, 220-232 (2012).
[21] F. K. Hussain, O. K. Hussain, Towards multi-criteria cloud service selection, Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS), 2011 Fifth International Conference on, 44-48 (2011).
[22] K. Iqbal, M. O. Odetayo, A. James, Content-based image retrieval approach for biometric security using colour, texture and shape features controlled by fuzzy heuristics, Journal of Computer and System Sciences, **78**, 1258-1277 (2012).
[23] S. Ando, A. Nakao, In-network cache simulations based on a YouTube traffic analysis at the edge network, Proceedings of The Ninth International Conference on Future Internet Technologies, (2014).
[24] D. S. Papailiopoulos, J. Luo, A. G. Dimakis, C. Huang, Simple regenerating codes: Network coding for cloud storage, INFOCOM, 2012 Proceedings IEEE, 2801-2805 (2012).
[25] P. Mell and T. Grance, The NIST definition of cloud computing, NIST, (2011).
[26] N. Carr, Cloud computing: The new spice trails, The big switch rewiring the world from Edison to google, WW. Norton, New York, 2008.
[27] G. Jones and C. Hill, Theory of strategic management, 9th edition, South-Western Cengage learning, USA, 2013.
[28] M. I. M. Copetti, Error analysis for a finite element approximation of a thermoviscoelastic contact problem, Journal of computational and applied mathematics **180**, 181-190 (2005).
[29] T. J. Reynolds and J. Gutman, Laddering theory, method, analysis, and interpretation, Journal of advertising research **28**, 11-31 (1988).
[30] J. Gutman, A means-end chain model based on consumer categorization processes, Journal of Marketing **46**, 60-72 (1982).
[31] J. Gutman, Analyzing consumer orientations toward beverages though means-end chain analysis, Psychology and Marketing **1**, 23-43 (1984).
[32] R. B. Woodruff and S. F. Gardial, Once and future products, The Journal of Business Strategy **17**, 11-12 (1996).
[33] T. J. Reynolds and J. C. Olson, The means-end approach to understanding consumer decision making, Understanding consumer decision making: The means-end approach to marketing and advertising strategy, Lawrence Erlbaum Associatesm, 1983.
[34] K. G. Grunert and S. C. Grunert, Measuring subjective meaning structures by the laddering method: theoretical considerations and methodological problems, International Journal of Research in Marketing **12**, 209-225 (1995).
[35] C. E. Gengler and T. J. Reynolds, Consumer understanding and advertising strategy: Analysis and strategic translation of laddering data, Journal of Advertising Research **35**, 19-33 (1995).
[36] A. Dibley and S. Baker, Uncovering the links between band choice and personal values among British and Spanish girls, Journal of Consumer Behaviour **1**, 77-93 (2001).
[37] N. Northcutt and D. McCoy, Interactive qualitative analysis: a systems method for qualitative research, Sage Publications, California, 2004.
[38] J. M. Juran, Juran on planning for quality, New York: Free Press, 1988.
[39] J. N. Warfield, An assault on complexity, Battelle Monograph Series, 1973.
[40] J. N. Warfield, Societal systems: Planning, policy, and complexity, New York: Wiley, 1976.
[41] H. M. Chuang, C. K. Lin, D. R. Chen and Y. S. Chen, Evolving MCDM applications using hybrid expert-based ISM and DEMATEL models: An example of sustainable ecotourism, The Scientific World Journal **2013**, 1-18 (2013).
[42] M. F. Ansari, R. K. Kharb, S. Luthra, S. L. Shimmi and S. Chatterji, Analysis of barriers to implement solar power installations in India using interpretive structural modeling technique. Renewable and Sustainable Energy Reviews **27**, 163-174 (2013).
[43] Y. Li and C. Zi, Analysis of load factors based on interpretive structural model, Journal of Computers **7**, 1704-1711 (2012).
[44] J. Corbin and A. Strauss, Basics of qualitative research: Techniques and procedures for developing grounded theory, Sage, CA, 1998.
[45] A. L. M Leão and S. C. Mello, The means-end approach to understanding customer values of a on-line newspaper, BAR- Brazilian Administration Review **4**, 1-20 (2007).
[46] M. Lombard, J. Snyder-Duch and C. C. Bracken, Content analysis in mass communication: Assessment and reporting of intercoder reliability, Human communication research **28**, 587-604 (2002).
[47] O. R. Holsti, Content analysis for the social sciences and humanities, Addison-Wesley Publishing Company, MA, 1969.
[48] G. P. Latham and L. M. Saari, Do people do what they say? Further studies on the situational interview, Journal of Applied Psychology **69**, 569-573 (1984).
[49] K. Salimifard, M. A. Abbaszadeh and A. Ghorbanpur, Interpretive structural modeling of critical success factors

in banking process re-engineering, International Business Research Conference Papers **6**, 95-103 (2010).

Huan-Ming Chuang is an associate professor of the Institute of Information Management, National Yunlin University of Science and Technology, Taiwan. He received the BS and MBA degrees from National Cheng Kung University and National Chengchi University, Taiwan, in 1979 and 1983, respectively. He received the PhD degree in Management Sciences from the University of Iowa in 1993. His current research interests include strategic information systems, marketing information systems, knowledge management, and business intelligence.

Chien-Ku Lin is a doctoral student of graduate school of Information Management, National Yunlin University of Science and Technology, Taiwan. He is also the information commissioner of ZoneIn International Inc., Taiwan. His research interests include information security management, electronic commerce, knowledge management, and customer relationship management.

Da-Ren Chen received his B.E., M.E. and Ph.D. degrees from National Taiwan University of Science and Technology, Taipei, Taiwan, in 1999, 2001 and 2006, respectively. Presently, he is an associate professor in the Department of Information Management at National Taichung University of Science and Technology. His research interests include real-time systems, wireless sensor networks, parallel and distributed computing and scheduling algorithms.

You-Shyang Chen, He is now an associate professor and chairman of department of Information Management in the Institute of Information Management, Hwa Hsia University of Technology, and majors in information management. He was ever a practitioner in the field of financial industry and manufacturing industry over 20 years. He received the Bachelor's degree in Industry Management from National Taiwan University of Science and Technology in 1988, and the Master's degree and Ph.D. degree in Information Management from National Yunlin university of Science & Technology in 2006 and 2009, respectively. His major research interests are financial analysis, medical management, soft computing, fuzzy time series, and rough set theory. He has published nearly 100 journal and conference papers.

Li-Chuan Wang is an Assistant Professor of the department of Multimedia and Entertainment Science, Asia-Pacific Institute of Creativity, Taiwan. She has a many year practice experiences in ISO Quality Control System, ERP Establishment, Human Resource Management, Corporate Identify System (CIS) and Internet marketing. Her current research interests include Multimedia Design, Cloud Computer Service in CRM and Qualitative research.