

Benchmarking Intellectual Capital Performance of Logistics Companies Using Analytic Network Process: A Conceptual Framework

Ratapol Wudhikarn, Gilles Neubert, and Nopasit Chakpitak

Abstract—This research aims to propose a newly improved benchmarking approach by concentrating on the rarely focused topic that is the hybrid concentration of logistics and intellectual capital (IC) management. The consideration and comparisons of logistics management integrated by IC management has been highly underdeveloped either in an academic or commercial perspective, even though these two beneficial methods have been widely recognized and applied for several years. Although, there are some past academic researches aiming to consider this underdeveloped issue, a number of studies are still very limited, and, moreover, they still mostly and separately focused on each element of IC, and also disregarded relations between IC elements. It is significantly apparent that the comprehensive consideration on IC elements in logistics is substantially rare, and existing managerial methods still could not properly cope with the specific characteristic of IC management that is the relations or influences among IC elements. Therefore, to improve this issue, this research aims to suggest a novel hybrid approach that could both consider comprehensive IC elements as well as their relations. The thinking and non-thinking IC concept is applied in the proposed model for comprehensively considering crucial details of IC management in logistics, while the analytic network process (ANP) is integrated with this model to consider the characteristic of IC management and also to emphasize the concentration and priority of IC management in organization. This proposed method is planned to be applied to benchmarking IC management among logistics firms in the future work.

Index Terms—Intellectual capital (IC), knowledge management (KM), logistics, analytic network process (ANP), multi-criteria decision making (MCDM).

I. INTRODUCTION

For several years, logistics management has been broadly recognized and identified as a critical operation conveying competitive advantages to organizations [1], [2]. From its crucial advantages, the logistics management has been widely and continuously developed in several areas, and one of important element, the performance measurement, has been also intensively considered and developed [3]. Similar

to other business domains, at the beginning the measurement of logistics is mostly stuck in financial concentration, whereas the management of non-financial assets academically known as intellectual capital (IC) has been highly ignored. Moreover, one of Okada's research [4] empirically identified that the IC management in logistics still has massive opportunities for improvement.

The researches of comprehensive IC measurement in logistics are still substantially limited, and, moreover among past studies, most of them still separately concentrated on each component of IC. There are few studies that extensively considered on all IC's elements. Nevertheless, all these researches still considered on the broad IC classifications that are categorized into three or four rough elements. From limited numbers of this hybrid subject, the past academic studies could empirically indicate the advantages of IC elements toward logistics efficiency. However, there is the critical concernment about limited resources of organizations directly influence the managerial capabilities. Therefore, in order to efficiently manage and improve logistics performance under scanty resources, the realization of importance of all IC elements as well as their priorities comparing to competitors are unavoidable. Hence, to deal with the mentioned issues, this study aims to propose the benchmarking approach as well as the priorities of IC measures with an appropriate method.

II. LITERATURE REVIEW

Intellectual capital is academically defined as values of non-financial assets of organization. It was firstly and unintentionally suggested by Galbraith [5] who aimed to discover the variance between book values and market values of organizations. This is quite similar to the proposed concept of Edvinsson and Malone [6] who attempted to find the difference between financial assets and investor-perceived values. Nowadays, IC management has been widely recognized as critical managerial tool for modern economy [7], since it could bring several advantages to organizations including strengthening organizational wealth [8], enhancing financial security [9], conducting to new managerial approach [10], measuring knowledge management achievement [11], improving non-financial assets [12] and so on.

Regarding to substantial advantages of IC management, therefore, in past decades, there were several proposed IC management approaches including Skandia value scheme and Skandia navigator [6], thinking and non-thinking IC [13], intangible asset monitor [14], value chain scoreboard [15], national intellectual capital index [16], balance scorecards or

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R. Wudhikarn is with the College of Arts, Media, and Technology, Chiang Mai University, Chiang Mai, 50200 Thailand (e-mail: ratapol.w@cmu.ac.th).

G. Neubert is with EMLYOM Business School, Saint-Etienne, 42100 France (e-mail: GNEUBERT@em-lyon.com).

N. Chakpitak is with the International College of Digital Innovation, Chiang Mai University, Chiang Mai, 50200 Thailand (e-mail: nopasit@camt.info).

BSC [17], and so on. Most of IC concepts [18], [19] classified IC compositions into three broad dimensions; those of human capital, customer or relational capital, and structural or organizational capital. Nevertheless, among these proposed concepts, one of comprehensive model considering on broad IC dimensions including competence, attitude, intellectual agility, relations, organization and renewal and development; is thinking and non-thinking IC [13], and this comprehensive IC model can be depicted as shown in Fig. 1. In past decades, several proposed IC methods widely adopted in several business areas such as finance, manufacture, electronics, service, etc. Nevertheless, the study of IC in logistics domain is still underdeveloped and there are massive opportunities of improvement [4]. Actually, there are several logistics-related studies concurrently considering on IC concepts, but most of

these researches separately concentrated on each IC composition; including human capital [20], [21] customer or relational capital [22], [23], and structural or organizational capital [22], [24]. Nevertheless, there are some rare past studies that concurrently considered on all IC elements, but all researches still applied the traditional compositions of IC that are quite rough. Wu and Chou [23] examined interrelationships between IC elements; those of human capital, structural capital, and customer capital; and holistic performance of IC in logistics, and the study empirically indicated that entire elements influenced the overall performance of IC. Likewise, another study [25] that found positive influences of IC elements over the logistics operations.

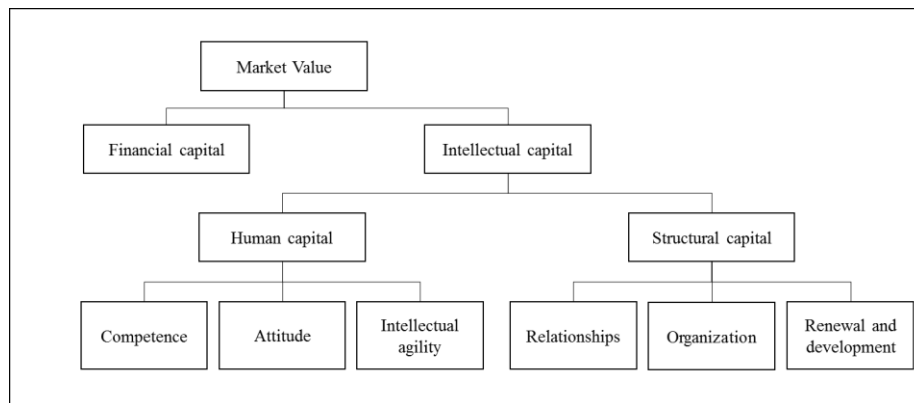


Fig. 1. Thinking and non-thinking IC model [13].

As presented, the studies specifically concentrated on the IC management in logistics are still limited, and one of critical reasons possibly come from the vague identification of performance measure and its importance. The high priorities of IC indicators could lead to efficient resources management and allocation. Nevertheless, the identification and selection of elements and also relative indicators are sophisticated processes that require experts [26]. Nevertheless, experts hardly make a decision on diverse and various key performance indicators (KPIs), and in-appropriate decisions could lead to a wrong and inefficient management.

Therefore, to cope with the complicated issue of IC management, a proper decision method is highly required, and a multi-criteria decision making (MCDM) method is empirically identified as the appropriate method for the multiple criteria problem that is a basis characteristic of IC. Hence, several scholars applied MCDM to better improve the IC management. One of distinctive methods that has been used with IC management is analytic hierarchy process (AHP). This method was applied with the IC management studies [27]-[29] in order to improve the IC management model. Nevertheless, AHP typically does not consider relationships or interdependences between IC's elements as most of MCDM methods such as the technique for order of preference by similarity to ideal solution (TOPSIS), elimination et choix traduisant la réalité (ELECTRE) I and II, etc.

Therefore, former studies have still inappropriately improved the IC management by excluding the dependency consideration. Nevertheless, there is the MCDM method

which still considers relationships between the considered elements that is analytic network process (ANP). Therefore, there are some researches applying ANP to improve the IC management approaches including BSC [30]-[32], three categories of IC [33], Skandia navigator [34]. However, the studies integrating IC methods with ANP are still limited especially in the area of logistics management.

From thorough reviews, there are only two studies adopting the IC concept using ANP. Ravi and colleagues [35] implemented the integration of BSC and ANP in reverse logistics, and suggested that this hybrid approach could provide more accurate output for identifying and prioritizing performance measures. The advantages of this approach was confirmed again by another research also implementing in logistics industry [36]. Although this hybrid technique could provide a new way to improve the problem of inappropriate decision, however these studies still have some limitation on the consider of traditional rough components of BSC including finance, customer, internal process and learning and growth. Moreover, all those rare researches were still stuck in considering on prioritizing logistics KPIs of one organization. Therefore, this approach could not properly suggest the improvement to other organizations, since one focused company is unable to benchmarking the differences among several companies and to accurately suggest improving opportunities for other underdeveloped organizations also.

In conclusion, from the intensive literature review, no past study has examined the IC management in logistics with the more comprehensive IC model, and, moreover, no study that compares the IC performance among various logistics

organizations by using the method that could provide the priorities and importance of indicators also.

III. RESEARCH FRAMEWORK

Regarding to the literature review, there are two major improving opportunities on the IC management in logistics domain. The first gap is the improvement on the comprehensive consideration on more detailed IC elements, since the past approaches examined the IC elements in the broad scopes according to the applied concepts. The latter opportunity is the benchmarking of IC measurement priorities in logistics business in order to perceive the differences and improving opportunities between high and low performance organizations. Therefore, in order to cope with expected improvements, the methods that can improve those issues are screened from their characteristics and advantages as mentioned in the previous section. Two methods including ANP [37] and thinking and non-thinking IC concept [13] are suggested to deal with the multi-criteria decision problem with interrelationships among various elements and the comprehensive and detailed consideration on IC elements respectively. From these selected methods, the research framework can be demonstrated as Fig. 2.

As presented in Fig. 2, the proposed framework refers two types of methods; those of managerial and multi-criteria

decision making method. Before applying the IC method following the thinking and non-thinking approach, the IC indicators of logistics related-activities are searched and obtained from all relevant articles in well-known academic databases including Science Direct, Emerald, Springer, and Taylor and Francis. Several keywords combined and used for searching in the academic databases are logistics, supply chain, intellectual capital, IC, intangible assets, performance measure, key performance indicator, and KPI. All obtained measures from this process will be classified into six IC dimensions following thinking and non-thinking IC concept [13]; those of competence, attitude, intellectual agility, relationships, organization, renewal and development. Thence, all categorized indicators will be used for creating a questionnaire that will be sent to all focused organizations for selecting and identifying the currently applied IC-related indicators in each logistics organization. Consecutively, the selected and indicated measures are applied as elements for constructing network models relating to each organization. Following the ANP approach, each indicator is assigned as element in the created network model, and all measures are then classified as parts under clusters following thinking and non-thinking IC dimensions. For example, the indicator of logisticians' skills will be categorized as an element under the cluster of competence in the network model.

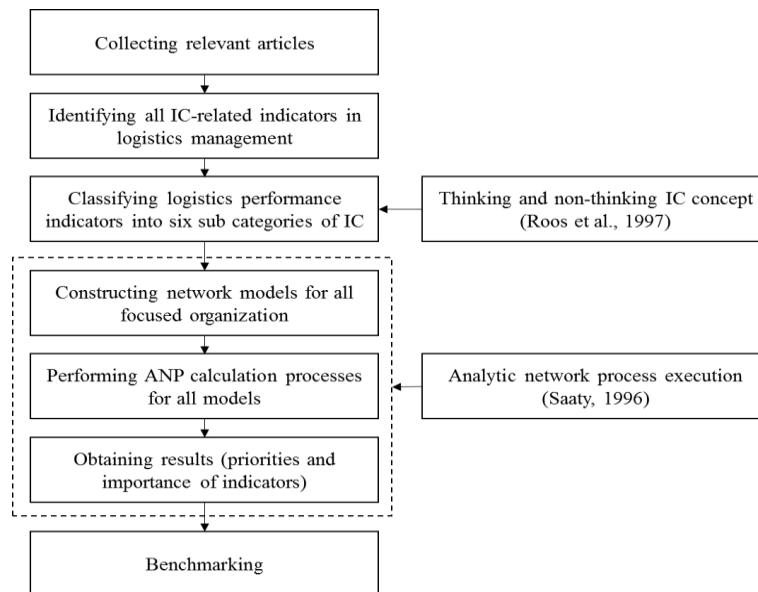


Fig. 2. A conceptual framework of research.

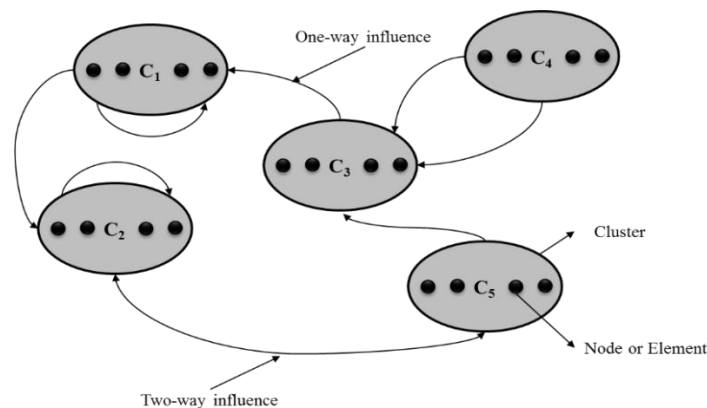


Fig. 3. An example of network model [38].

Therefore, in order to create the complete network model of each logistics firm, the identification of relations among all IC-related indicators (elements) is then specifically indicated by each organization. Each IC-related indicator (element) is entirely considered and identified for the influences to other measures (elements). If there is the dependency between indicators (elements) within the same category of IC (cluster) is termed as the inner dependence, whereas the relationships of indicator (element) with other measure (elements) outside the IC dimension (cluster) is termed the outer dependence. For example, if one of indicator (element) relating to logisticians' knowledge under the competence cluster influence to another measure that is logisticians' innovative suggestions under the same cluster (competence), this is classified as inner dependence, whereas the index of logisticians' knowledge influence to customer service level under another cluster or relationships, so this is termed as outer dependence.

All relationships between elements and clusters could be created as a dependency network map for ease of use as an example presented in Fig. 3. A relationship between elements within a cluster or inner dependence is presented by a looped arc, whereas a line with one way or two ways of arrow connecting between clusters representing the outer dependence. After identifying the dependency models for all organizations, pairwise comparisons between entire relevant elements and also clusters of each constructed model are then executed via questionnaires to identifying the priorities of concentrated elements of each organization. The scores of pairwise comparisons are 1-to-9 scales as proposed by Saaty [39], and details of these comparing scales are presented in Table I.

Finally, when obtaining the priorities and importance of IC measures, these results are applied for benchmarking the differences among concentrated organizations. The priorities and weights of importance of all considered indicators are expected to demonstrating the different concentration or management between modern, or global organizations and traditional, or local organizations. In summary, the results will provide the concentration on IC management for all focused logistic organizations through the priorities and weight of IC performance indicators of each firm, and the gaps between organizations can be applied for analyzing the organizations' improving opportunities.

IV. CONCLUSION

Today, logistics has been widely recognized as a critical operation in high competitive business, since it could provide several advantages to organizations. Although the logistics management has been improved for several decades, however for non-financial management scope, it is still rarely considered and studied. Therefore, this study aims to considering on the intellectual capital management between the logistics management by applying the novel method integrating two different concepts; those of the thinking and non-thinking IC and analytic network process. For the proposed method, the IC model is applied for demonstrating the non-financial measurement of organizations, while the ANP is used to prioritizing the importance or concentration of organizations on IC elements. In the future work, the

suggested method will be applied with four different logistics providers in order to benchmarking and finding the different concentration on IC management between high performance and low performance organizations.

TABLE I: PAIRWISE COMPARISON SCALES OF ANP [39]

Score	Definition	Explanation
1	Equal importance	two elements or clusters contribute equally
3	Moderate importance	experience and judgement slightly favor one element or cluster over another one
5	Strong importance	experience and judgement strongly favor one element or cluster over another one
7	Very strong importance	element or cluster is strongly favored over another one and its dominance is demonstrated in practice
9	Absolute importance	importance of one over another affirmed on the highest possible order
2, 4, 6, 8	Intermediate values	used to represent compromise between the priorities listed above

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Ratapol Wudhikarn is an assistant professor and lecturer in the Knowledge Management Department at the College of Arts, Media and Technology, Chiang Mai University, Thailand. He holds a doctor of philosophy degree from the Chiang Mai University. His research focuses on intellectual capital management, multi-criteria decision making, and operation research. Recently, he has published papers in several well-known journals such as management decision, Journal of Quality in Maintenance Engineering, Benchmarking: An International Journal, and International Journal of Production Research. He currently serves as an assistant to the dean at the College of Arts, Media and Technology, Chiang Mai University.



Gilles Neubert is a professor and lecturer in operations management of EMLYOM Business School, Campus Saint-Etienne, Saint-Etienne, France.



Nopasit Chakpitak is a dean and lecturer of International College of Chiang Mai University, Chiang Mai, Thailand.