Use of a Decision Support Model for Information Technology Evaluation in Cuban Enterprises

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Abstract

The need to satisfy a more demanding customer in a scenery where deadlines and costs must be ever smaller to maintain competitiveness, together with increased uncertainty about demand, has been leading organizations to collaborate to such a level that now the competition is not between isolated enterprises, but between supply chains. The information technology management and the integration of information systems in such environment are complex problems, aggravated by the selection complexity of a combination of technologies to support, to the greatest possible extent, the supply chain performance. This paper presents a decision support model based on compensatory fuzzy logic, to facilitate the selection of technologies to be used for integrating the information systems in a supply chain, and provides two examples of the model diagnosis phase impact in Cuban organizations.

Keywords: Decision Support, Integration Technology Selection, Supply Chain Management, Compensatory Fuzzy Logic

1. Introduction

Contemporary business environment is strongly tied to Supply chain management (SCM), which is a coordination and collaboration challenge that require a decision making process based on the latest and best information from every component of the chain in order to archive a better total system performance rather than optimization of single members. [1-4]. This inter-organizational collaboration requires information exchange among organizations nowadays geographically disperse across the globe.

Such information exchange, collaboration, and inter-organizational decision making is eased by information systems (IS), which presently strongly supported by information and communication technologies (ICT).

Yet, IS evolution has resulted in a surplus of applications that are not designed to exchange information among themselves and to use that exchanged information; in other words, there are many IS that are no able to work in a interoperable way, [5-8], letting a long way between the high-level vision of the integrated supply chain and the basic reality in the development and implementation of these needed supporting technologies. [5, 9, 10]

In this area, ICT evaluation and selection based on business requirements is an open research field due unsolved organizational needs and insufficient or flimsy inter-disciplinary approach [8]. Cuban enterprises are no exception. There are findings explaining problems and improvements needed by Cuban companies [11-13]. Among these problems evaluation and selection of ICT, in context of Strategic Information Systems Planning, is becoming pressing matter [14-16], especially when it comes to diagnosis of IS/IT for its management according business strategic objectives [11, 14].

This paper gives some insides on TEMIX, which is a decision support model to facilitate the selection of ICT to use for integrating IS in a supply chain, and its Diagnosis stage application in Cuban enterprises as a supporting tool for IT management.

2. Decision Support Model

The fundamental question of the given problem is in determining how good a combination of technologies for the integration of certain supply chain is. The hypothesis is that a combination of technologies is good for a supply chain if it satisfies the requirements of integration in this type of chain, applying the rule that the characteristics of an integration requirement determine which technologies, or combination of technologies, can be "suitable" for the chain. This last issue introduces vagueness in the analysis because it depends on the criterion of more or less experienced people.

In this scenario several aspects should be considered: first, the procedure for validation of the hypothesis involves the participation of those interested in the decision (decision makers), whether supply networks managers interested in acquiring the technologies or providers of integration solutions.

Secondly, the way in which technologies meet integration requirements is a fuzzy variable, given the terms "good" and "important" that can be used to quantify the veracity of the hypothesis. These terms allow a scale in natural language that captures the decision makers' perceptions regarding the veracity of the hypothesis. This scale of subjective values (such as very good, good, fair or bad) can be turned into numerical values between 0 and 1, seeking to reach an objective sort of the priority with which technologies should be considered for application in certain types of chain, despite the subjectivity of the scale used to obtain the criteria for decision-makers.

Thirdly, the supply chain types (i=1,...,M), the integration requirements (j=1,...,N) and technologies or technology combinations (k=1,...,L) used in the model must be previously defined. These three aspects constitute theoretical basis of the model, therefore, the more objective and explicit definition made of them the better the outcome. At present the number and diversity of technologies, the highly specific and vaguely spelled out integration requirements, and the many dimensions that can be applied to classify supply chains are significant barriers to integration technology choice.

A decision model draft is presented on Fig. 1. TEMIX can be divided in 3 stages, those are:

- Preparatory phase: initial definitions to the decision process.
- Diagnosis phase: diagnosis of the main features of the supply chain under scope, and definition of relevant issues to the decision process.
- Main phase: definition of the integration requirements that describe each chain type, the satisfaction that the technological combinations give to those requirements, and the importance of such combinations to the supply chain type. Finally a ranking of technologies is obtained.

In the following headings these stages are explained in greater detail.

The existence of this model can allow try several scenarios for those involved in the decision process before the final selection of technologies is made. Among the possibilities may be the evaluation of the existent technologies, not only the assessment of new ones; the tryout of possible scenarios by changing preferences along the process and see the consequences. The effects over the system (express in quantitative manner) of different technologies, integration requirements, return of the investments, cost, barriers and other factors in the adoption of technologies is expected to be helpful to senior managers in the supply chain as well as technology providers.

2.1. Decision Support Model Preparatory Phase

Before the first use of the model, a preparatory phase is necessary in order to design a primary knowledge base that can support the elaboration of questionnaires. These questionnaires play a fundamental role as communication channel between the involved decision makers or stakeholders and the decision model. The primary knowledge base, in order to support this, must contain a first version of the definitions used in the model, paying great attention to the theoretical bases of the model, as well as possible ways to make questions to the people involved in the decision process.

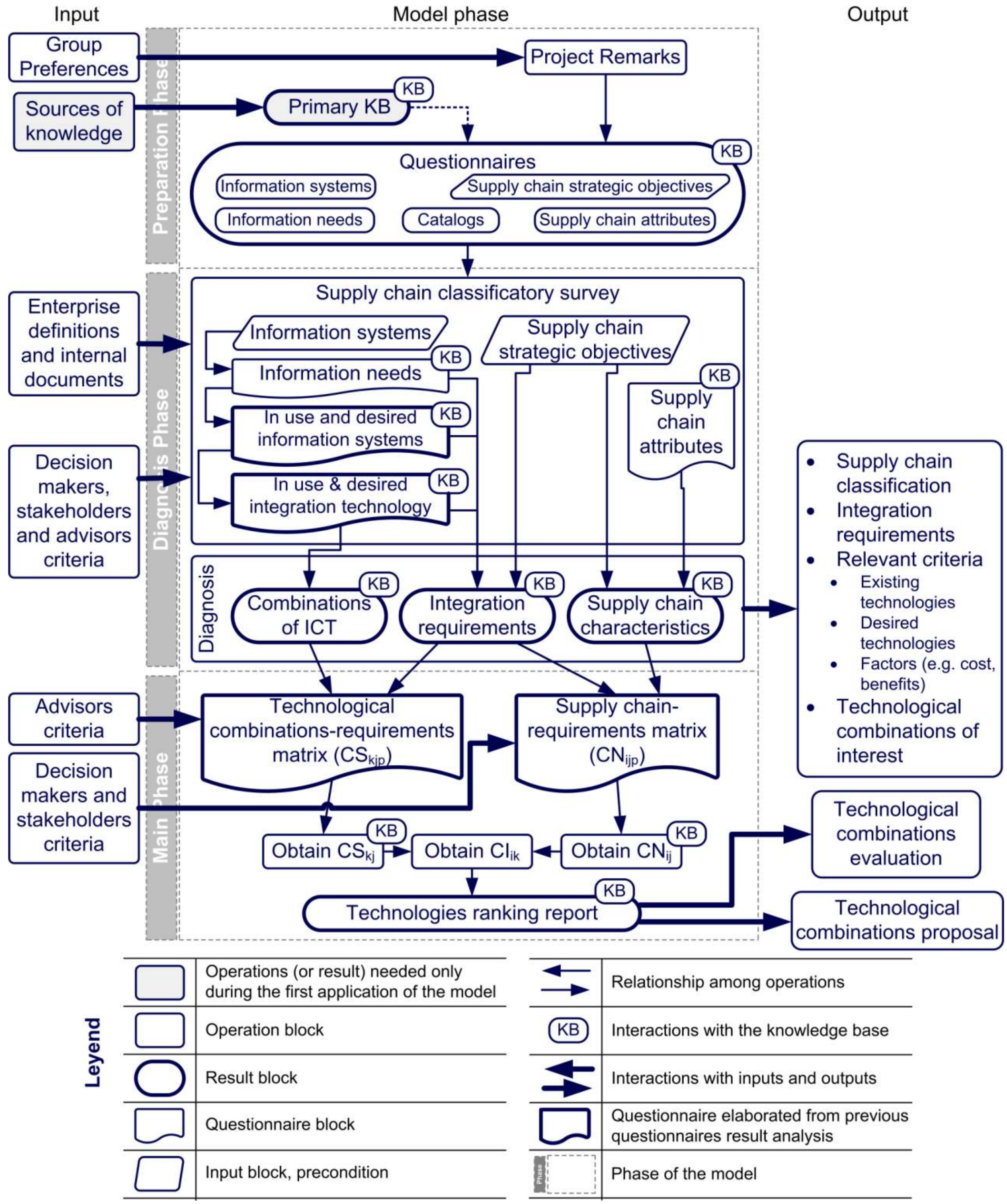

Fig.1. Decision Model (Source: Authors)

The supply chain types under consideration are the four related to the development of the supply chain.[1] These groups will hardly change, yet the criteria under consideration to classify a supply chain into one of these types can be very diverse. The differentiation among consecutives groups can be difficult because there is no clearly defined frontier among them. Bottom line, the criteria to differentiate between supply chain types, and the required processing given to it, are in the interest of the primary knowledge base.

The integration requirements are a completely different mater. Their definition depends on the business objectives and goals, so they are meant to change over time. Then the knowledge related is important to reflect the true necessities of the system in the time being, and in the future.

Before proposing new combinations of technologies for the supply chain, the existing technologies must be properly identified. The technologies in use can rise as constraints for the establishment of new ones. Also the desire or preferences of the decision makers or stakeholders regarding new technologies must be taken under consideration, not only from a technological perspective, but from a strategic and financial point of view as well.

Furthermore, a detailed analysis of the relationships among the supply chain integration requirements and the information systems integration technologies is required. It is estimated that this relation should be established through an information system type classification as the ones used by Themistocleous [8], due to the fact that this systems constitute the link between these integration technologies and the essential needs of decision makers or stakeholders.

Last, but not least, there is the need to determine the involved people in the decision project, not only those who are going to make the decision, but those who may be responsible for the project (distribute and gather information, start and end the project, process the information, and so on). These initial actions must take place each time the model is implemented.

2.2. Decision Support Model Diagnosis Phase

This phase can be considered the most important one for many enterprises, especially those with ill understanding of IT management importance or large deficiencies in this area.

This phase objective, as it name tells, is a diagnosis of some aspects of the company´s supply chain, as well as IS in used or needed and its supporting technologies.

Questionnaires (first time designed or upgraded) are submitted to previously selected decision makers or stakeholders to make the diagnosis of the supply chain under analysis.

The consulted sources to elaborate the primary knowledge base and the questionnaires may not the same consulted to gather information in the diagnosis phase, so an update of the ways to ask could be done based on the application of the questionnaires. Once that this new knowledge is gathered, there is the possibility of improving the design of the original questionnaires.

Based on the decision makers or stakeholders opinion the supply chain under analysis can be categorized into one supply chain type and a diagnosis of it in the time being can be establish. The diagnosis will allow the setting of the values needed in order to proceed to the assessment of the technological combinations.

Through this process also must be done a definition (and quantification) to the greater possible extend of criteria influencing the adoption of the integration technologies. These factors can include [17] cost, benefits, return of investment. They will constitute an important influence in the determination of the ranking of technologies by reinforcing or diverting the interest of the decision makers or stake holders towards one or another technological combination. Nevertheless, more deep analysis is required with the purpose of implement these considerations into the model.

There are two different set of questionnaires (supply chain characterization and IT related) and two main respondent groups (decision makers and stakeholders, having a business perspective, and advisors regarding integration technologies and IS). Questionnaires have been divided in sets of questions to facilitate respondents understanding and answering process.

Supply chain questionnaires recollect information regarding the product line around which the supply chain is build, supply chain and company strategy, performance indicators, the organization, supply chain topography, and supply chain integration.

IT related questionnaires are divided mainly in information flow (information needs from each departments) and support technologies.

The information flow´s category links information used at strategic level to IS currently implemented in the supply chain, to assess the level of utilization and importance of such information needs and IS from the perspective of polled persons. The questions, arranged by processes, include the availability, importance, functionality, processes of origin, processes of destiny, generation frequency, and systems that support each information need.

This list of information needs must be generated from internal documents, procedures and company staff experience, although there is a version of questionnaires in case an organization is not interest in this analysis. To ease respondents task associating each information need to its supporting IT, a preliminary analysis of documentation of the IS implemented into the organizations is desirable, or the results of previous surveys.

Support technologies questionnaires seek to assess the ways in which users access the information they need, the ways they trust more, and importance, usability, reliability, and user-friendliness in which they consider IS they are using to obtain information they need.

Once that the information needs are associated with software in use is possible to classify applications according their importance to the company, and ease their management by detecting overlapping in functionalities or systems that are not needed.

Based on this first part of the support technologies questionnaires, relevant application and IT are detected and used to elaborate a new set of questions.

This second part of the support technologies questionnaires is submitted to IT advisors (internal or from third-companies) to establish integration technologies currently been and those compatible with relevant applications, allowing establishing the relevant IT catalog.

At the end, the results are lists, catalogs of relevant combinations of technologies, relevant integration requirements and supply chain characteristics used to the third phase survey.

2.3. Decision Support Model Main Phase

The main phase of this decision support model is centered on the fundamental part of the decision procedure. Once the significant issues have been set there is the possibility to put together the decision matrices that will serve to clarify which integration requirements describe the analyzed supply chain type and the fitness of the combinations of technologies for the different integration requirements.

Evaluation can be accomplished thought three main steps.

The first step ends on determining the extent in which the integration requirement (j) is necessary for the performance of the given supply chain type (i), expressing such a result in the so-called coefficient of necessity (CN_{ij}), as represented in Fig 2.

The values of the coefficient are obtained from the opinion of several people, as will be explained later. This opinions are expressed in a common language scale (e.g. bad, more bad than good, regular, more good than bad, good) in order to express how much necessary a integration requirement can be for the performance of a supply chain (CN_{ij}) or how much satisfaction provided the combination of technologies to that requirement (CS_{kj}). These scales in natural language can be quantified in a number between 1 and 0, where the 1 is the total belonging and the 0 is out of the class. So the CN_{ij} and the CS_{kj} are a number between 1 and 0 that can be translated or interpreted in natural language.

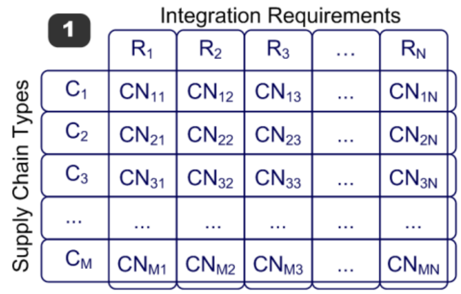

Fig. 2. Result from step 1 (Source: Authors)

The second step, that can be done simultaneously with the first (see Fig. 1), is focused on obtaining the coefficient of satisfaction (CSkj), expressing the extent in which the technology (k) satisfies the requirement (j), as shown in Fig. 3.

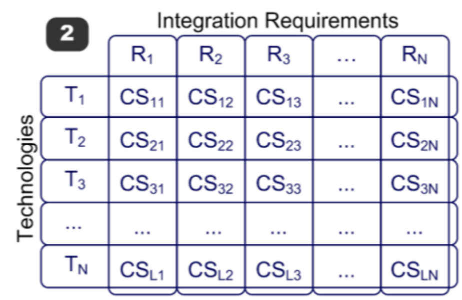

Fig. 3. Result from step 2 (Source: Authors)

The third step aims to obtain a sub-matrix from the matrix built in step 2, searching the coefficient of fitness (CF_{kj}) for each pair “technological combination-integration requirement” regarding to a specific supply chain type, as shown in Fig 4, as an inter-medium stride to find the so called coefficient of suitability (CI_{ik}) that correspond to the technological combination k for the supply chain type i. A matrix to each type of supply chain is generated as result. Each one of these matrixes is the base to obtain the ranking of technological combinations in those chains types.

In order to do so, only the significant requirements (columns of matrix in step 2) for the i-th desired supply chain are taken into account, considered as significant those requirements in the matrix in step 1 with, for example, $CN_{ij} \geq 0.6$, as shown in the example of Fig. 4. Then the ordering of the technologies could be obtained.

1	R1	R2	R3
C1	0.7	0.2	0.8
C2	0.3	0.5	0.6
C3	0.9	0.8	0.6

2	R1	R2	R3
T1	0.3	0.8	0.6
T2	0.3	0.5	0.4
T3	0.6	0.7	0.9

3 for C1	R1	R3	Order
T1	0.46	0.69	0.56
T2	0.46	0.57	0.51
T3	0.65	0.85	0.74

1	R1	R2	R3
C1	0.7	0.2	0.8
C2	0.3	0.5	0.6
C3	0.9	0.8	0.6

2	R1	R2	R3
T1	0.3	0.8	0.6
T2	0.3	0.5	0.4
T3	0.6	0.7	0.9

3 for C_2	R1	R3	Order
T1	0.63	0.6	0.62
T2	0.5	0.49	0.49
T3	0.59	0.73	0.66

Fig. 4 Example (Source: Authors)

The example focuses on determining the priority with which three different combinations of technologies (T1, T2 and T3) should be considered for the chain C1. From the first step significant requirements are obtain, which exclude R2 due CN12 < 0.6, therefore the matrix in the step 3 does not consider it, resulting T3 the "better" technological combination for that supply chain.

The technological combination ranking shown in the example is obtained through the ordering of the suitability coefficient (CI_{ik}), which is calculated as shown in Eq. 1.

$$CI_{ki} = P(k,i) = \forall_j [N(i,j) \wedge S(k,j)] \qquad (1)$$

This expression in common language terms expresses that the suitability of a technological combination of integration technologies for a given supply chain depends on the measure in which this combination can fulfill the integration requirements forced by the performance of the supply chain in question, where:

- P(k,i): The technology k is important for the chain type i. Have the same mining than CI_{ki}.
- S(k,j): The technology k satisfy the requirement j. Have the same mining than CS_{kj}.
- N(j,i): The requirement j is necessary for the chain type i. Have the same mining than CN_{ij}.

The fuzzy quantifications earlier discussed bring the need of a fuzzy approach, yet the compensatory fuzzy logic (CFL) was selected over the classical fuzzy logic to obtain the ordering of technological combinations.

2.3.1 Calculating CI_{ki} through CFL

The "ability" of a technological combination for enhance supply chain performance is associated to the (non-strict) fulfillment of the supply chain integration requirements. The selection process of such combination requires the integration of the different supply chain partners points of view in an environment were generally the IS keep more attention from the decision makers, eclipsing the integration technologies that must be used to communicate these systems. Additionally integration requirements are not explicitly defined and they are as diverse as the several decision makers' priorities are.

Problems with similar features can be solved by means of a decision support model with a fuzzy approach. These models usually combine simultaneously all criteria of a given alternative through a specific expression,[18] which in this case correspond to the one shown in Eq. 1. Using these measures of fulfillment an available technological combination ranking can be established.

However, in Fig. 5 there is an example using the operators of the fuzzy logic to calculate CI_{ki}.

1	R1	R2	R3
C1	0.7	0.2	0.8

2	R1	R3
T1	0.3	0.6
T2	0.3	0.4
T3	0.6	0.9

3	R1	R3	Order
T1	0.3	0.6	0.3
T2	0.3	0.4	0.3
T3	0.6	0.8	0.6

Fig. 4. Example using fuzzy logic (Source: Authors)

Fuzzy logic calculates the conjunction operator ($\wedge$) and the "for all" operator ($\forall$) using the minimum.[19] As result, with such ordering is not possible differentiate between the first two combinations of technologies. Therefore, a more involving approach was desirable.

Compensatory fuzzy logic (CFL) is a new approach with some advantages over classical systems, precisely because it is a non-associative multivalent system that incorporates the benefits of fuzzy logic and also facilitates the compensation of the truth values of some basic predicates with others, in a vision that unites the modeling of the decision and the reasoning, as explained in several investigations [20, 21]. As shown in Fig 5, the obtained values using CFL are more sensitive than the fuzzy logic.

With the CFL the conjunction operator ($\wedge$) and the "for all" operator ($\forall$) are calculated using the geometric mean, as shown in Eq. 2. Applying the geometric mean a sensitive value to all elements in the scale is obtained, without giving so much meaning to the extreme values. The geometric mean also fulfill the compensation, symmetry, growing and strict veto axioms [21].

$$P(k,i)=\sqrt[n]{\prod_{j=1}^{n} \sqrt{N(i,j)\cdot S(k,j)}} \quad (2)$$

In other words CIik is the conjunction of all the CFkj for the same combination of technologies, as shown in Fig. 6.

	R_1	…	R_N	Orden
T_1	$\sqrt{CN_{M1}*CS_{11}}$	…	$\sqrt{CN_{MN}*CS_{1N}}$	$\sqrt[N]{\Pi}$
T_2	$\sqrt{CN_{M1}*CS_{21}}$	…	$\sqrt{CN_{MN}*CS_{2N}}$	$\sqrt[N]{\Pi}$
T_3	$\sqrt{CN_{M1}*CS_{31}}$	…	$CN_{MN}*CS_{3N}$	$\sqrt[N]{\Pi}$
…	…	…	…	…
T_L	$\sqrt{CN_{M1}*CS_{L1}}$	…	$\sqrt{CN_{MN}*CS_{LN}}$	$\sqrt[N]{\Pi}$

Fig. 5. Calculating CF_{kj} and CI_{ik}

2.3.2 Several Decision Makers

As said before, in order to quantify the satisfaction of a technological combination to the requirements of a supply chain (CS_{kj}), and the how much a requirement is necessary for the performance of a supply chain (CN_{ij}), as shown in the matrices obtained in the steps 1 and 2 (see Fig. 2 and 3), it is necessary to consult several decision makers (p). Each person can give different values of CS_{kj} and CN_{ij}, that's why it could be as many matrices 1 and 2 as people involved in the decision process.

The setting of CS_{kj} and CN_{ij} can be done through a qualitative evaluation in common language that reflects the ambiguity of such evaluation. For example the scale to use for the CS_{kj} could be: very bad, bad, regular, good and very good. This evaluation could then be quantified in agreement to the decision makers' criteria, and then set up a signification threshold.

The common language terms that can be used for the CN_{ij} hold a greater subjectivity due the different perceptions that the decision makers could have about the performance of different supply chain types. For example: in the selection of a supply chain information system, a desirable feature can be "make to order" or "make to stock". These requirements have been considered as a typical behavior of agile and lean supply chain respectively,[22] and vice versa.[23]

Once that the decision makers' criteria are known, it is necessary to unify them into a single quantitative expression that reasonably represents the behavior of all these opinions, even when the extreme values in the scale are included. Again is desired the conjunction of all the collected criteria, and the solution approach was again the CFL. It was used as shown in the Eq. 3 and 4.

$$CN_{ij} = \wedge_p CN_{ijp} = \sqrt[p]{\prod_{p=1}^{P} CN_{ijp}} \quad (3)$$

$$CS_{kj} = \wedge_p CS_{kjp} = \sqrt[p]{\prod_{p=1}^{P} CS_{kjp}} \quad (4)$$

Where:

- CN_{ijp} is the coefficient of necessity of the requirement j for chain type i given by the person p (p=1,…,P).
- CS_{kjp} is the coefficient of satisfaction of the requirement j for the technological combination k given by the person p.

CN_{ijp} and CS_{kjp} are subjective values that quantify each decision maker perception, while CN_{ij} and CS_{kj} represent a sort of consensus for a group of decision makers, that's why step 3 will result in a unique ordering of importance for a given set of technological combinations, considering a specific type of supply chain previously defined.

It is considered that the CN_{ijp} should be obtain from a group of decision makers or stakeholders more related with a business perspective (e.g. supply chain senior managers) and the CS_{kjp} should came from decision makers or stakeholders more involved with technological problems, such as integration solution providers. In this manner, these two perspectives can be united by relating technologies and supply chain types to the same integration requirements.

3. TEMIX Diagnosis Phase in Cuban Enterprises

The practical application of the model is intended by means of a web based application, named TEMIX, which stands for “TEchnology Mix”.

TEMIX has been developed through a series of evolutionary changes based upon user feedback regarding practical appliance of the proposed model. These continuous iterations have been helpful during the process of turning the solution idea into a concrete proposal as well as during the validation of the findings.

TEMIX development trough interactive prototyping was related to its application in QUIMEFA (a business group selected for the first application).

3.1. Application Quimefa

The Chemical Pharmaceutical Enterprise Group (QUIMEFA), is integrated by 21 enterprises, to know: 12 pharmaceutical laboratories, 4 medical supplies producers, 2 trading companies, and 3 service providers. The process of procurement, production, and distribution are accomplished by different (legally independent) enterprises, with common objectives, therefore, QUIMEFA, by itself, can be seen as a supply chain that implements a centralized decision making approach.

The group´s is focused on import, production, warehousing, distribution, transportation, and commercialization among the country´s health institutions as well as for exportation. It has close relation as supplier and service provider with other enterprises of the National Medicament System, such as: hospitals, pharmacies and laboratories.

When it comes to daily practice about ICT selection in enterprises, it seems that technologies to integrate systems are chosen based on technological novelty and characteristics, yet the role and characteristics of the organization as member of the supply chain are easily overlooked. In surveyed organizations: FARMACUBA, ENCOMED, two Laboratories and QUIMEFA´s central offices [24] integration requirements are verbally described, yet when some documentation exists there is no evident relation with supply chain goals, only with specific departmental needs inside the enterprise that are close to the technical requirements detected. There were not found any procedure or tools supporting the technological selection process, besides managers and technical staff intuition, knowledge, and in some cases, requirement engineering and project management practices.

These findings are consistent with the reviewed literature about lack of tools to assess technological combinations [25, 26], highly varied and specific supply chain integration requirements [27] leading to diverted attention to technology requirements while supply chain requirements are neglected [25], and therefore, integration solutions not oriented to business requirements [28, 29].

Managers, in many cases, cannot provide accurate assessment regarding ICT to integrate the IS they use, while technical staff cannot establish on their own which requirements may be more important to the organization.

In order to strengthen the strategic information system planning process taking place in QUIMEFA, the group decided to assess its IT, specially their current and desired future IS. They saw the in-progress development of TEMIX as an opportunity to achieve an easier alignment of their IT resources with their objective and strategy, evaluating these technologies in a less uncertain environment.

The preparation and diagnosis project was program for eight months, as shown in Figure 7. Future applications will take less time since questionnaires design is complete, and will have a different arrange of tasks, leaving preparation phase mainly to a study of relevant information (e.g. project definitions and respondents for diagnosis and main questionnaires selection).

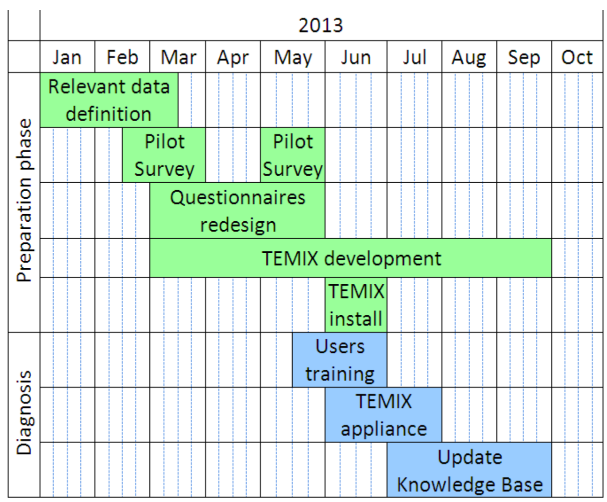

Fig. 6. Preparation and diagnosis phase planned schedule for Quimefa

As result from preparatory phase in QUIMEFA, besides the project remarks, must be mentioned that questionnaires to be used during diagnosis phase were made by first time, and iteratively tested with QUIMEFA’s managers help, allowing to improve the way of ask about academic subjects into a practical approach. Therefore groundwork to future applications was successfully set, all as result of the first application of the model.

Results from surveys during diagnosis phase reveals a hybrid strategy with distinctive lean character during the production process and slightly more agile strategy during distribution, with a defined supply (second maturity level of four where the forth one is the higher one) and with strong elements of market dominance and blocking (behavior type 11) within the medical national market. This findings are consistent with conclusions from [30, 31] describing low integration of Cuban and Latin-Americans´ supply chains.

Integration requirements for the group were identified, and ICT combinations of interest were detected based on most widely used and important systems, as well as integration technologies related to them. The 24 IS currently in use [24] were analyzed to detect these combinations.

Based on detected information requirements and their analysis by QUIMEFAS personnel, some decisions were made. One IS was consider unnecessary due business process evolution. Other 3 systems were considered unnecessary since all information provided by them was contained in others. From the remaining 20 IS, 17 were proprietary systems and 12 of them were under license agreement. They were turn into 12 new IS to support business processes, abiding by ministry and government policies by migrating to open source software while reducing licenses cost.

3.2. Application in Movitel

Movitel is a company belonging to the Cuban Ministry of Communications that provides mobile radio services to national organizations. The company´s more important service, with the more significant income levels and number of customers, is radio trunking. In order to provide services, as well as related marketing and supporting communications network, the company has responsible offices in all provinces of the country. Besides communication services, Movitel offers handsets with their needed accessories, as well as repair services for the equipment it sells

Movitel requires provider to cover different types of needs, such as equipment associated with network infrastructure and cellular phones and accessories for sale, which are obtained from companies like Electronic TAIT, New Zealand (original provider) thought Copextel (inmediate provider and marketer). As for the services required, the main provider of communications network support is ETECSA. Additionally, the company turns to national suppliers for materials and other assets necessary for its internal functioning.

In order to fulfill its goals, Movitel use ITs to ease their tasks and to manage its processes information, yet their situation regarding IT management is similar to QUIMEFA, although an information system plan is not a priority.

Movitel´s personnel considerer they have high level of IT exploitation, since they have several systems that ease their tasks regarding the company´s processes information management. Since its establishment, indeed the organization has introduced a series of IS that facilitate and expedite the development of various functions such as accounting, sales, inventory, etc. These systems have been acquired or developed as they have been needed by the organization departments and not resulting from a holistic analysis of the processes and their information requirements.

This has led to the use of systems that do not communicate with each other, duplication of stored data, using tools to import and export data manually and information requirements are not fully covered by the IS in operation. In consequence, information associated with various processes must be managed by the staff using several systems at once, been the person the one in charge for the information flow among the different systems, without a clear procedure for it. This causes some degree of inconsistency in the information handled by having duplicate data and be updated differently by various directions of the company.

While seeking a solution to these problems, Movitel considers necessary to diagnose the company´s current situation in terms of IS in use and the information requirements covered by these systems. The unplanned adoption of systems has been consider a fundamental cause to the organization current situation, therefore, this diagnosis will be an initial phase within an Information Systems Plan for the company.

The selected method was TEMIX, been in preparation phase, as shows Fig 8 schedule. A first application of the questionnaires will be considered a pilot test to update the knowledge base associated with the model in case needed. Once is certain that questionnaires' ways to ask are in-line with the company, the surveys will extend to other workers to complete the diagnosis.

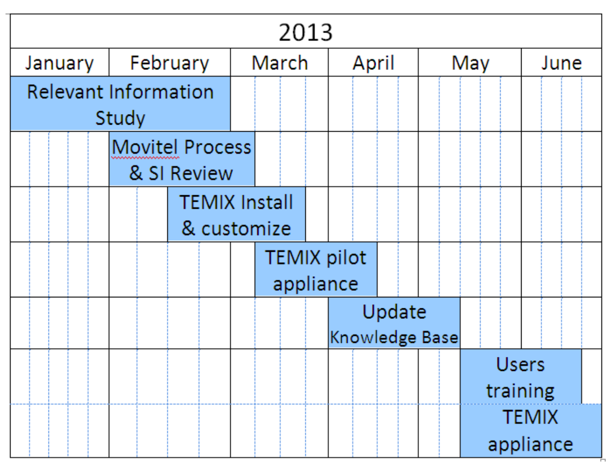

Fig. 7. Diagnosis phase planned schedule for Movitel

So far, pilot questionnaires have been applied to seven workers. Respondents were selected among company senior manager involved in key processes, that are considered (by other managers and by themselves) well informed regarding the company and master their work, and have more than 10 years of experience in the business.

Based on gathered responses have been documented a few information needs with low availability and high importance for a key business process. Such findings are the foundation that senior managers were expecting to take action. In addition, these results from pilot survey will be used to explain the importance of the Information System Plan to the whole company and expected benefits from it, in order to ensure staff cooperation.

4. Conclusions

In this paper a decision support model based on fuzzy logic is introduced to deal with the subjectivity and vagueness present in a decision situation where several people, even from different organizations, are involved in the selection of information technologies to be used for supply chain integration.

The model has been used in Cuban enterprises as a support to the Information Systems Planning process, being the diagnosis phase the most attractive one to senior managers.

The proposed model allows the analysis of "what if" scenarios by changing the preferences of the involved people proposing consistent courses of action.

The model considers the potential compensations that may occur due to different measures in which combinations of technologies are able to meet certain supply chain requirements for non-dominant cases, as those caused by changes in the preferences of those involved.

The fact that decision makers or stakeholders select the coefficients of the matrices in steps 1 and 2 from scales formed in a natural language makes easier the process for them, even in the case when they are not familiar with the used approach.

The use of compensatory fuzzy logic constitutes a stronghold of the proposed model, expressing a more sensitive result, nearer to the human cognitive process than other approaches.

TEMIX, the prototype tool supporting the proposed decision model, has been considered by senior managers as a way of document and manage information needs, and a helpful tool in decision making regarding IT management.

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