CONCEPT FOR A SUPPORT ENVIRONMENT TO IDENTIFY COMPETITIVE INFORMATION SYSTEMS OPPORTUNITIES

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1. Introduction

Over the past years there has been growing interest in the use of information systems technology (IST) to gain competitive advantages. The use of Information System Technology (IST) to build Competitive Information Systems (CIS) raises a number of questions. Areas of interest are, amongst others, how to identify opportunities for CIS, how to evaluate these opportunities and how to implement CIS.

Before any information system with strategic impact can be implemented, the idea for it has to be identified. This idea has to be concrete in the sense that it is applicable to the specific firm that it has been targeted for. As analysis in itself does not lead to the creation of such concrete application proposals, we present questions to a user as stimuli. The application proposals are the expected responses. These questions can be generated systematically and cover a set of issues completely, thus enhancing the users capability to provide concrete application proposals. The issue then is to capture these responses. This leads to a symbiotic relation between a system providing stimuli in the form of questions and the user providing the ideas. One major issue is how to focus the stimuli (questions) generated by the system. This paper concentrates on how to generate questions to stimulate ideas for CIS opportunities and proposes a model based tool to support this process.

The remainder of this paper is organized as follows. The next section gives a short overview of the previous research. In section three we discuss some issues which need to be considered in identifying opportunities for CIS. Section four describes a general model of question generation for the use in CIS identification. Section 5 describes the proposed support environment.

2. Previous Research

Currently most researchers in the field claim that information system technology can provide competitive advantage [4,9,13,14,17,18,25,26]. This is done by compiling cases [25,26] and identifying a framework for classification [9,25]. A number of frameworks have been proposed to arrive at application ideas to gain insight into the competitive advantages IST might offer. Examples of these approaches are Porter's [19,20] competitive strategy framework and its applications by McFarlan [15], Parson's [17] differentiation of industry, firm and strategy levels, Ives and Learmonth's customer resource life cycle [9] and Wiseman's strategy action generator [25,26]. Previous research has investigated the competitive potential of CIS and has provided a range of possible frameworks.

One of the concerns with most existing research stems from the question addressed. From a firm's perspective, ultimately, the concrete application idea is what is sought; mechanisms to identify potential areas are just hints in that search. This problem of non-applicability results, even if a framework confines itself to a narrow and predefined application area [5]. The large gap between the formulation of a general framework and its application to a firm or business unit exists as long as there is no support for this process.

One way to support the process of analysis was reported in Krcmar [10]. A part of the Information Management System was built to help analyze the possible impact of IST on competitive forces. During its use, a large number of remarks, on what could be done to influence these forces, was typically generated by the participants in trying to answer the questions. Similar results are reported in [23].

We therefore conceptualize a system, which not only helps to analyze the possible impact of IST, but also allows for the capture of application ideas that individuals come across during this process.

3. Issues in identifying Opportunities for CIS

An idea in the context of this article is a concept of a concrete information system, which might create a competitive advantage. It represents a generic idea, applied to the firm after becoming acquainted with a framework or system of categories. This idea typically will describe how the envisioned system works and not how it will be developed and implemented. To be communicateable an idea also has to be formulated. Often ideas are formulated in a discussion as a reaction to a question brought forward.

A major reason for the importance of idea identification is the 'preemptive' nature of a successful CIS. They tend to help dominate a market, block distribution channels or involve large learning costs for competitors, who want to stay in the market. Once they introduce a new organizational state of the art, it becomes necessary for industry participants to offer the same type of service. It seems intuitively important to be first to reap the benefits.

Creating ideas for CIS is very much an issue of 'what you know is what you will see'. Creating ideas then means identifying opportunities. One answer to the question of why the competitive possibilities of IST are only now receiving attention, is that 'they have not been seen before' [26]. The conceptual view of the relationship between IST and strategy plays a major role in our ability to influence this relationship and to create ideas or see opportunities. Also, only those applications can be identified in principal which are 'inside' a conceptual framework. However, this conceptual blindness is inherent to any preformulated process of discovery. Success for a specific company might result from using existing, but yet not employed frameworks and from the process of critiquing the existing frameworks.

Being systematic or complete is another issue. Completeness and systematicness are linked to the framework employed and can only be measured within it. Only on an industry level the general impacts of IST can be systematically described. Completeness can be assumed when all promising issues have been addressed.

Ideas which can bring competitive advantages are not necessarily confined to the top echelons of an organization. As CIS's are more outside bound than previous MIS systems, a bottom up approach could help to identify opportunities in relation to customers or suppliers. Also, the process of strategy making itself plays a very important role in the strategy's success. The process of generating ideas might well be as important as the planning results themselves [1,22].

4. A Model of Idea Identification for CIS

The process of idea identification has two distinct phases :

(1) The generation of a stimulus (question).

(2) The formulation of an idea (related to that stimulus).

As the first part will be performed by a machine system and the later by the user, we will concentrate on what questions to generate as stimuli. For that purpose we describe a simple model for question generation. To allow a focused questioning process, an extended model for question generation will then be developed.

The reason to look at ideas for CIS could be stated as follows: "The firm faces changes in Information technology. The firm needs ideas to use changes in Information technology." . This would determine the need to do something. It does not give a hint of what to do. A refined description sounds like this: "Information technology impacts the firm. The firm needs ideas to take advantage of these impacts". This description changes the perspective. The firm is now interested in harvesting the impacts, not the technology itself. Based on this description three variables can be deducted. These are 'firm', 'information systems technology' and 'impact'.

We model the IST involved and the possible impact types as two separate variables. This allows us to employ a multitude of conceptual views of types of impact and the differentation of IST. We assume that a firm will have one or more representations to model its reality. It is possible to look at the firm as having generic strategies or as being characterized as a collection of value generating activities.

Ideas to take advantage of the impact of IST on the firm are then concerned with a relation, formed by an instantiation of the variables "REPRESENTATION", "IMPACT-TYPE", "INFORMATION-SYSTEMS-

TECHNOLOGY". This relation is called linkage. Linkage can be established without regard to a specific company on an industry level. One can systematically ask questions about "possible" linkages to trigger ideas. The assumption is, that for every linkage an idea might exist. Figure 1 shows this simple model for question generation.

An example: A linkage might be "Retail banking relies heavily on the advance in communication technology to define new financial products". This linkage can be transferred into the question "How can we (the retail bank) use communication technology to define new financial products to obtain competitive advantage?".

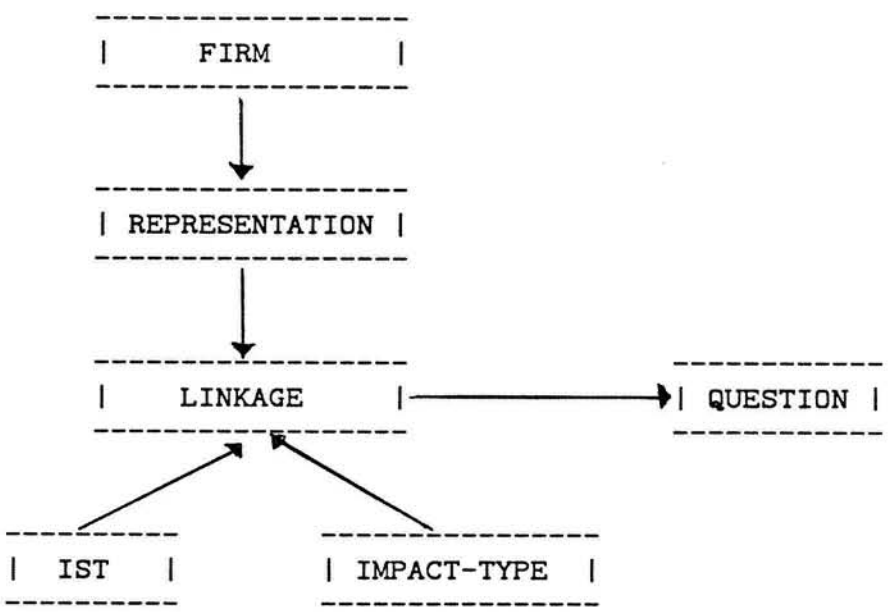

Figure 1: Simple model for question generation.

This model can be instantiated by deciding, which instantiations to choose for the variables 'representation', 'IST' and 'impact-type'. The questions to be answered for this instantiation are:

1. What organizational unit are we looking at ? This is typically a business unit of a larger firm or the firm itself.

2. How is the unit being represented ? There exists a large variety of representations to look at an organizational units. Each of these representations captures different aspects of an organizational unit as a whole.

3. How do we define and look at Information Systems Technology ? It is possible to differentiate between aspects of IST. This can be done technically or functionally oriented.

4. What possible types of impact of IST are we looking at ? The impact of IST on the oragnizational unit can also be viewed from different perspectives.

Answering these questions could result in the following instantiation:

```
REPRESENTATION I    : 8 elements of a value chain.
REPRESENTATION II   : 5 competitive forces.
IST                 : 3 functional classifications.
IMPACT TYPE         : 3 types of impact (on product or services,
                      internal organization, customer/supplier).
```

Based on this example, we will now describe the questioning process. Questions are of the type

```
How can you use <IT-element> to <impact-element> for
<representation-I-element> and <representation-II-element> ?
```

Figure 2 shows an example of a rule of the question generating process.

```
If the competitive target is "supplier"
   If the value activity is "inbound-logistics"
      If the technology is "communication technology"
        If the impact-element is "new product or service"
-->
Then ask
" How can you use communication technology
  to define new products or services
  for the inbound-logistics activity for suppliers? "
```

Figure 2: Rule for question generation

If there is already an example which describes that type of an application, the question might be put as: "Can you place terminals at the sites of the suppliers, as in the such and such case ? ".

For each business unit considered, the above instantiation results in 8x5x3x3=360 possible questions for ideas on opportunities. It is therefore necessary to reduce the numbers of questions asked. The reduction mechanism focusses on important ones so that less than the maximum number of questions will be asked. The reduction mechanism relies on information other than is represented in the model of question generation. We assume that information about the strength of the prevailing competitive forces, the chosen strategy and the importance of internal activities, will especially help to reduce the number of questions generated. Information on these aspects can be obtained through separate analysis modules [2,10]. We thus introduce a selection mechanism between all linkages and the questions asked.

Several ways to find "promising" questions can be offered:

1. Ask only for these combinations of variables, when all elements are above a threshold. These thresholds could be separationalistic or combinatoric and on a industry or company level. This approach will be described in more detail in the rest of this chapter.

2. Ask more questions where successful applications are known. The system might ask, if an example might be imitated.

3. Ask only, if the critical assumptions in a linkage hold. The assumptions expressed in a linkage have to be tested if they hold for the specific business unit. The assumptions in the example are "Bank wants to offer new products", "communication is necessary to offer new products". Thereby assumptions might be surfaced and evaluated [8].

4. Ask, if not enough ideas have been obtained. Should the reduction of questions lead to an insufficient number of stimulated ideas, both the reduction rules could be changed. Earlier analysis could also be repeated.

The first aproach can be described by the following rule:

```
If representation-element is above importance threshold
  If ISt is above availability threshold
    If Impact-type fits strategy
Then
  question about tripel {R,IST,IMP} to obtain idea for this
  tripel
```

This leads to an extended model of question generation. Figure 3 indicates the additional analysis modules proposed to reduce the number of questions generated. The simple model for question generation becomes part of the CIS idea identifier.

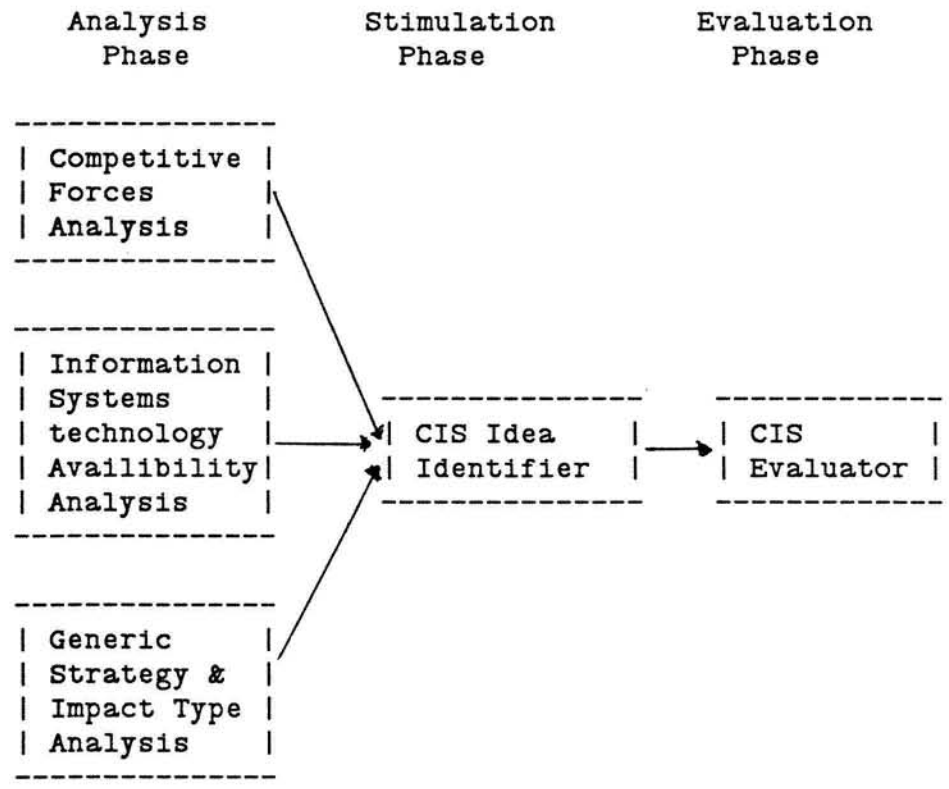

Figure 3: Extended model for question generation.

The company specific knowledge is the information obtained about the current situation of the company and the result of different analysis. The user responses form the facts of analysis. The results of the analysis are stored. An example of the competitive forces analysis is shown in figure 4. The combination of the indices indicates, about which triples to ask.

Competitive Force	Relative Strength Index of Force	Relative IST Potential to impact Force	Results of Combination of Indices
New Entrants	High	High	High
Suppliers	Medium	Medium	Medium
Buyers	Low	Low	Low
Substitutes	High	Very High	High
Rivalry	Very High	Very High	Very High

Figure 4: Analysis of Competitive Forces and IST Potential

From this analysis the following rules (figure 5) for reduction can be used to determine which competitive forces the system should ask about. These forces are called 'target forces '. The strenth indices as shown in figure 4 have been converted to numeric values.

```
If the strength of the bargaining power of supplier > .5
   If the impact of IST this force > .6
-->
The target force is suppliers.

If the strength of the bargaining power of suppliers < .5
  If the strength of other forces is > .5
-->
Remove suppliers from the target force list.

If the impact of IT on suppliers < .5
  If the impact of IT on other forces >.5
    If the strength of suppliers is between 0.5 and 0.7
-->
Remove suppliers from target force list.
```

Figure 5: Selection Rules for Strategic Targets

5. Proposal for a Support Environment

Using the proposed support environment involves two phases:

1. Customization phase
   (a) Identify the combination of frameworks (instantiation).
   (b) Build a company specific data base through analysis.

2. Usage phase
   (a) Idea stimulation phase.
   (b) Idea evaluation phase.

In the customization phase business planners will fill the system with the required company specific knowledge. First a combination of conceptual models has to be chosen. Then the different analyses have to be performed.

The idea stimulation phase provides a question session about CIS opportunities. The questions will be selected according to rules about which linkage is important for that specific situation. Possibilities to facilitate the idea formulation process besides the asking of questions are familiarization with concepts and showing of possible examples to trigger the phantasy. This could be provided though embedded explanation facilities of the support system. The responses to the questions will be captured.

To capture an idea, the user will type in the text describing the idea. The user will also be asked if the proposal links to any already existing information system, which specific internal and external organizational units will be involved, and a judgment of the expected perceived degree of impact. More than one idea can be entered to any question posed.

AI techniques can be used to construct such a tool. Through the ability to represent the knowledge they enforce a consistent and operational description of underlying business policy models. They allow to specifically address explanation and maintainability issues. We propose the use of AI techniques because:

1. They allow to combine numeric reasoning (results of analysis) with the symbolic reasoning of the representation, the logical reasoning of the rules and the heuristic reasoning to reduce the search space.

2. The knowledge in the system is both content and process bound. The rules describe the steps to be taken whereas these steps themselves are ultimately dependent on the contents.

3. The user of a system can obtain explanations about the questions. Uncertainty and contradictory evidence can be handled with the inference system. Incomplete knowledge could be represented and processed.

4. Components of learning and natural language processing could be added more easily.

The system consists of four parts: the user interface, the inference mechanism, company specific knowledge, and general knowledge. The user interface accepts data and queries from the user. It converts them into the internal representation. Query facilities allow inquiries about the knowledge base, seek explanation to the system provided inferences, and modify the state of the knowledge base. The knowledge base consists of company specific and general knowledge. General knowledge consists of conceptual models brought into the knowledge base during the customization phase. These are examples for the different representations, impact models, the rules for the linkage between representation elements, IST and impact types. The company specific knowledge, as the results from the different analysis is obtained from the users.

A basic trade off in knowledge representation is between "expressibility" and "tractability" [11]. Expressibility is the ease with which we can naturally represent the information and deduce inferences from them. Tractability is the

ease with which we can process the information in a short period of time. Logic based representations are more expressible whereas linked representations are more tractable. For our purposes both the parameters are equally important because we need to represent diverse knowledge and time is crucial. Hence we propose to use a hybrid implementation approach. For availibility reasons, the rule core of the system is at present (May 1986) being implemented in PROLOG at New York University.

6. Conclusion

The proposed system combines a systematic and process-oriented approach to opportunity identification. It tries to support the ill-structured yet relevant process of idea generation for CIS. The system builds upon a symbiotic model with each partner contributing his advantage [27]. The system contributes its ability to ensure consistency and handle the complex interactions, while the users contribute their judgment and innovative ideas. The system allows for the creation of ideas about the competitive usage of IST in an organization by active involvement, and for the collection of ideas about CIS, which have been stimulated by systematically asking questions. From an overall perspective, the question capture, even though not at the core of the system is as important than the ability of the system to stimulate these ideas.

The approach is different from a Delphi approach [7] as it tries to expand the perceived space of opportunities. It thus does not try to produce one coherent view or list of ideas with which all participants agree. This approach is also different from other analysis oriented systems like Situation Analyst [16] and ANSPLAN [2]. Its main premise is not analysis, but rather the triggering of new ideas through questioning. It follows Ackoff's [1] concepts of interactive planning and planning as a continuous process.

The system can be used for different purposes. As a consultant the system helps to identify application ideas with greater consistency. In this function, it also

works as a tailored checklist. It thus ensures that each individual responds to all relevant questions. By storing the results of previous analysis it can help novices gain insight into the business and its decision process. As the overall framework allows to use different concepts of representation it helps to improve the experts insight by providing alternatives.

As a business oriented system, the validity of all stored knowledge has to be explicitly stated to allow checks for continued applicability. Many of the limitations are attributed to the fact that the domain of CIS is "wide and shallow" whereas successful expert systems are in domains which are "narrow and deep" and backed with a well defined theory. In the domain of CIS the concept of information systems technology is not yet ultimately defined [3]. Designing a system along these lines helps to clarify these 'soft' areas.

Enhancements of the approach are possible in a number of ways. It might lead towards computer conferencing systems or even to a group negotiation support system to help arrive at a consensus about the evaluation of ideas. Also natural language analysis might be used to identify common ideas or common characteristics of the idea texts.

In itself the approach does not bring out completely new or "break-through" CIS applications. This task rests completely on the individual user and for the foreseeable future will not be included into the support environment.

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