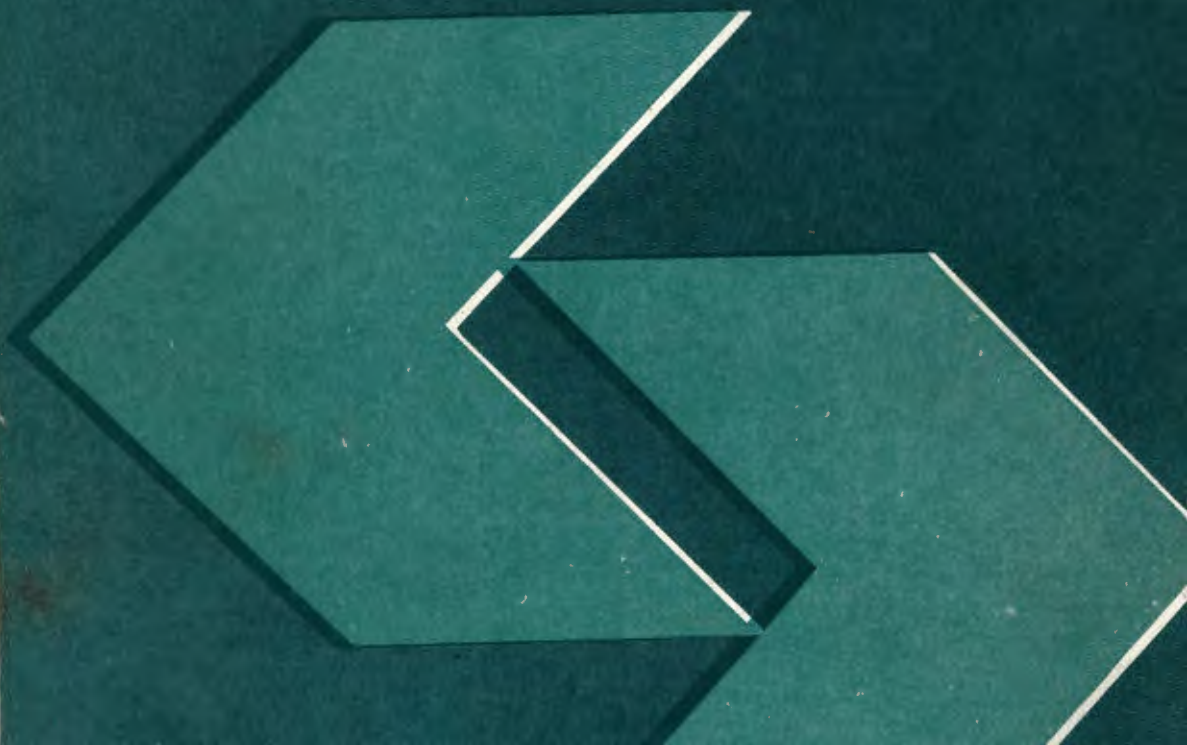Polska
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Methodology and applications
of decision support systems

Proceedings of the 3-rd
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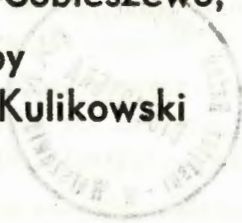Gdańsk-Sobieszewo, September 26-29, 1988

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EXPERT SYSTEM FOR INFORMATION TECHNOLOGY
STRATEGY FORMULATION IN WHOLE SALE BUSINESS

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CONTENTS

1. INTRODUCTION

This article deals with the problem of formulating the information technology strategy (ITS) of a company.

ITS means a definition of the general lines along which the information systems will be developed in the next years. It consists of the following[1]:

- criteria for evaluating and prioritizing applications
- principles of resource allocation and technological choice
- explicit plans, coordination guidelines and planning procedures whit appropiate controls and incentives.

Every company should have an ITS because otherwise

- the systems development work may be done for past or present situation instead of the future plans
- there may be a large number uncoordinated projects going on in the company
- the company may miss some new opportunities of IT

In many companies the role of IT is nowadays moving from the support of routine operations to a competitive weapon. The executives play an essential role in this change. They know the strategies of the company and this information should be the basis for planning the future information systems. The formal planning methods in system analysis and system design do not generally lead to this information. Therefore we need other and somehow softer methods in that work. Such methods are interviews, observations, discussions etc.- but they should and could be used in a systematic way too.

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[1]   Ari Vepsäläinen 1986

We have carried out the ITS planning process in three different companies. Our method is based on the ideas of F.Warren McFarlan at the Harvard Business School, which have been largely discussed and further developed in many papers at the 80's[2]. One of the cases is a whole sale company in consumer goods business. All the examples in this article are based on that particular case.

Next we are going to formulate a model of the relationships between the strategy of a company and the components of ITS. This model will be programmed with an expert system generator and is ment to be a tool for members of ITS planning project group. This program is under construction.

2. THE IT STRATEGY PLANNING PROCESS

In developing ITS we use a process which is described in the picture 1.
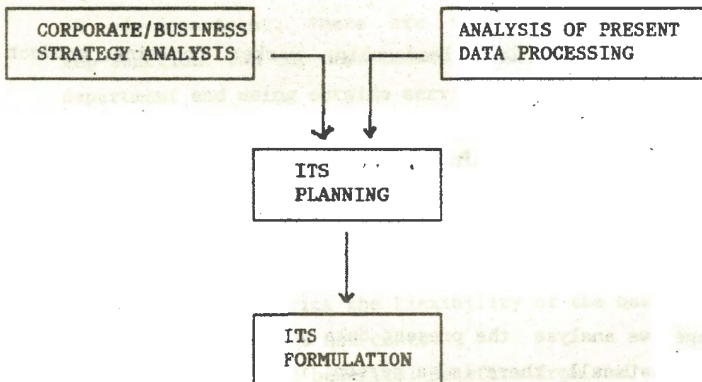
Picture 1. The prosess of formulating ITS[3]

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[2]   See McFarlan and McKenney, Parsons, Konsynsky and Cash, Earl etc.

[3]   Tapio Reponen presented this idea in the II FINNISH-POLISH SYMPOSIUM 1986

First of all we must point out that success in carrying out the process depends on the people involving it. We need a project organization which is occupied in a proper manner. In the project group there should be the line managers from the most important functions of the company and some edp-professionals. Very important is also the support of the managing director to the project. When we start the project we always train the project group first so that we all have "the same language".

There are **four stages** in the process. <u>In the first stage</u> we study the strategy of the company for the next five to eight years. When we know how the business is going to change, we can say how the information systems should change. Method in this stage is interviewing. We discuss with the key persons about the future business. The managing director is one of them. After discussions we have an idea of the main trends. By interviewing the middle-stage managers we go then deeper into the subject. Our aim is to analyse the business objectives in a long run.

When studing the strategy we use the main principles of Michael Porter's[4]:
- five forces driving industry competition (suppliers, buyers, substitutes, entrants and industry competitors)
- value chain with three stages (suppliers, internal functions and buyers)
- three generic strategies (cost leadership, market focusing, product differentiation)

This is the framework with which we discuss. We ask the managers to rank the importance of these forces, value chain levels and main strategies. There are with no doubt disagreements in this ranking, but with discussing, training and group working we try to find a concensus and then everyone must accept it.[5]

<u>In the second stage</u> we analyse the present data processing resources, both hardware and software. Usually there is a person in the edp-department who can give quite an exhaustive list about machines, applications and the on-going development projects. Then we additionally study the managers' opinions about the effectiviness of the systems. Here we again use interviews. Edp-

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[4]   Porter 1980

[5]   See both papers of Mikko Ruohonen

professionals and line managers very often disagree concerning the effecti-
viness.

Also a list of special skills of edp-professionals is needed. The future
systems must be based on the present ones, building totally new generation of
software is possibly only in small steps. Developing new systems and main-
taining old ones requires professionals and knowing their skills gives the
possibility to place them in projects they are suited for.

Third stage is the planning stage. It has following parts:

1 The critical success factors of data-processing. There are no universal
  list for those, they depend on the industry branch and the case.[6]

2 The opportunities IT offers for business. IT can be used in two ways to
  gain competitive advantage: using new technologies or using present
  technologies in a new way. Some examples of the highlights of today are
  inter-organizational systems (IOS), new methods in system engineering
  (CASE-tools), expert systems, artificial intelligence in production,
  videotex at home, use of bar codes and smart cards.

3 The competitive use of IT. The possible areas to beat competitors with
  IT are discussed in section 3.

4 The main principles of IT-management. Essential questions here are the
  position of edp-department in organization and the internal structure
  of edp-department. There are three basic alternatives how to handle
  edp-function: own edp-department, building a company from the edp-
  department and using outside services[7].

5 Strategic points of architecture. The architecture consists of four
  parts: data, hardware, application and communication architecture.
  Strategic means here that we study the business's demands for the
  architecture. The developing trends of the business should be taken
  into consideration when making plans about the general structure of edp
  because it can restrict the flexibility of the business.

6 Analysis of resources and costs.

7 Analysis of expected benefits. Benefits from the edp are always diffi-
  cult to estimate - future benefits specially.

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[6] The idea of critical success factors base on the articles of
     Rockart, Sääksjärvi (1984) presents some examples gathered from
     Finnish companies

[7] Tapio Reponen 1988

Fourth stage is decision making. There the company decides its ITS. This stage has following parts:

1 The links ITS has with companys business strategy.

2 The critical success factors of data-processing.

3 The goals using IT as a competitive method.

4 The main principles of management of data processing function.

5 The main principles of architecture.

6 Resources and expected benefits for carrying the ITS into practise.

When carrying out the planning prosess we have three main areas of matters to clear up:

- strategy (stage 1)
- the present situation of the edp (stage 2)
- the potential means to use IT as a competitive weapon (stage 3)

In every area our method is interviewing and we have a form for each one as a tool. There are two kind of questions in our forms: open questions which are answered verbally and propositions with a scale from 1 to 5 to be evaluated. These evaluations gives us a very useful tool to rank the importance of different potential and present applications in company. The open questions gives facts and general notions to be considered.

Interviewing is a very important part of the project. We choose the persons to be interviewed carefully. They should be very well aware about the future strategies in their area. In discussions with managers we use so called semistructured interviews, i.e. we give a form to the interviewee but fill it ourselves while discussing. It is quite a formal method allthough the interviewees may feel it informal and comfortable. We thing discussion-like aqcuisition of the data gives deeper information than pure questionnaries.

Some examples of questions used in a case in consumer goods business are listed in appendix 1.

3 COMPETITIVE ADVANTAGE WITH IT

There are four basic ways to achieve competitive advantage by using IT:
- improving the relationships to other companies, e.g. suppliers and customers
- increasing internal efficiency
- better decision support
- information intensity in products

In the relationship to the customers the main strategy is to build switching costs to them. That can be achieved with IT[8]. In improving its position to customers a company has two possible means:

1. offering them such services that are not possible without IT
2. reducing their costs

There are many succesful examples presented in litterature[9]. One very much used method here is the order entry system. When we offer customers such a system are able to get the following service:
- they can receive order status
- *they can make inquiries concerning* stock levels and delivery times of ours
- they can make inquiries concerning products and prices
- they can send orders directly to our system; that saves time when no phone calls is needed, increases the delivery time and saves costs of both customers and ours
- they can get the invoces and dispatch notes directly from computer to computer, which saves costs and work

When we have delivered the order system to our customer, he will not very easily change us to another supplier because of the changing costs and the service he would miss. This is along the basic ideas of Michael Porter[10]. The new ideas about open systems arcitecture may lessen this impact.

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[8] F. Warren McFarlan 1984

[9] See for example Buzzell 1985

[10] Michael Porter 1985

Other services we can offer to customers are technical assistance in product planning and offer planning. These are examples of planning activities for which computer programs can rather easily be build. Building both such planning systems and order systems are very large investment. Who would make these investments is discussed in chapter 5.

Customers costs can be reduced by order systems like presented above. Other methods are for example allowing them to use our computer or software or telecommunication network.

In the relationship to the suppliers a company tries to better its position against the supplier, that is, make it possible to change the supplier, make the supplier be dependent on the company and encourage them to competition[11]. IT can support this by reducing suppliers costs and giving better information about present and potential suppliers[12].

Increasing internal efficiency means bettering the level of operations and reducing costs. This is the oldest area in applying IT (personnel, administration routines, sales, invoicing and store checking routines, CAM) but there are still lot of doing.

One way to apply IT is merge IT in products, in other words, increase information intensity of products. Some examples of this are products including processors for controlling their functions (home electronics, radio telephones,...) and products including software which is used in micro computers for control and adjust the function of the product (indicators, machine tools,...).

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[11] Cash - Konsynski 1985

[12] F. Warren McFarlan 1984

4 FORMULATING THE STRATEGY

In final strategy formulation we start with the ranking list we made in stage
1 about main strategies and value chain stages. That list shows the primary
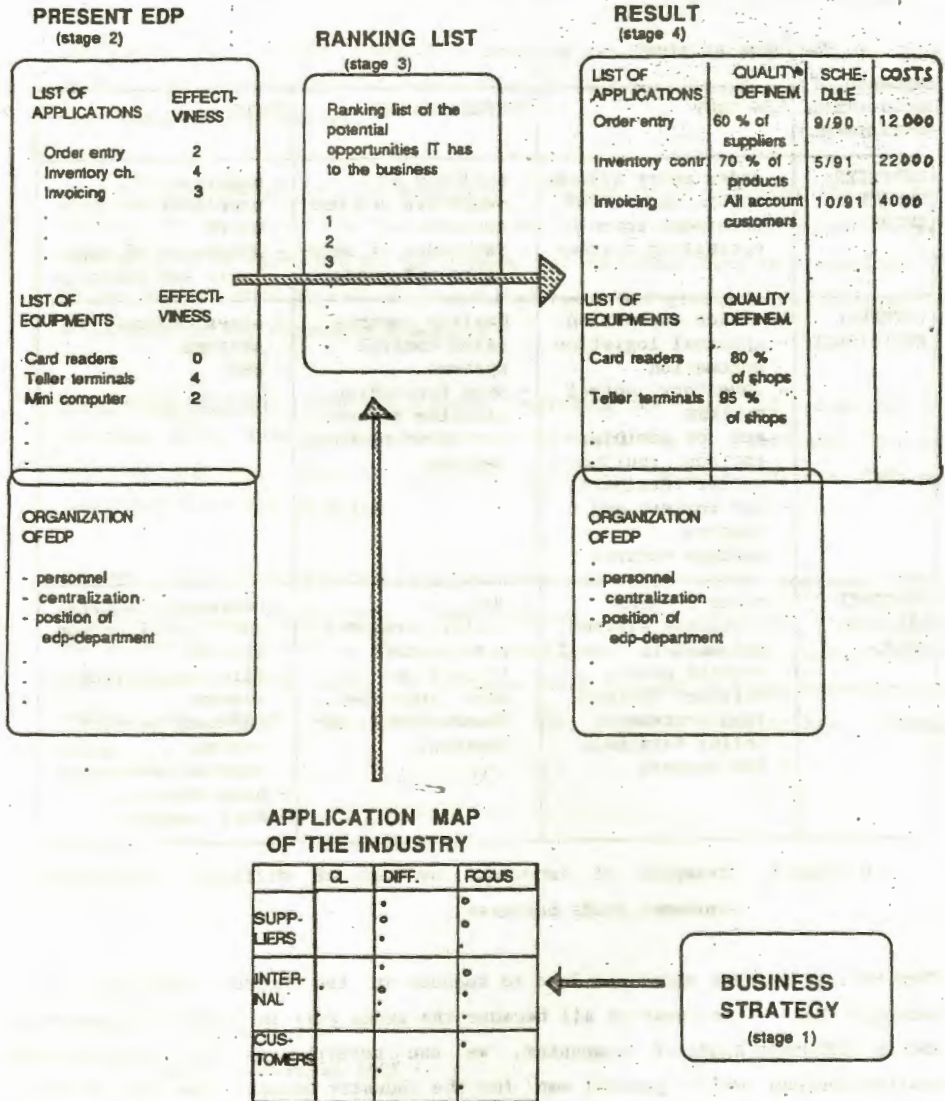areas in the application development.

Business strategy

Emphasis of application development	LOW COST	DIFFRENTIATION	FOCUS
SUPPLIER RELATION-SHIPS	- order entry systems - invoicing systems - transport route optimizing systems	- analysis of suppliers and products - databases of suppliers and products	- analysis of suppliers and products - databases of suppliers and products
INTERNAL EFFICIENCY	- office automation - internal logistics automation - inventory control systems - aut. of administrational routines - teller terminals - EAN markers and readers - wastage control	- quality control - sales control systems - shop furnishing planning systems - sortiment planning systems	- sales control systems - DSS
CUSTOMER RELATION SHIPS	- order systems - invoicing systems - EAN markers in self service points - delivery optimation systems - teller terminals - EAN readers	- JOT - teller terminals - card readers - IT services in shop (inquiries, reservations, automates)	- customer analysis and classification systems - direct marketing systems - customer service systems - customer databases - home shopping - card readers

Picture 2. Examples of important systems of different strategies in
consumer goods business

Then we list systems which can lead to success in the choosen strategy. Unfor-
tunately that is not easy at all because the means vary in different industries
and in different kinds of companies. We can nevertheless list an universal
application map and a general map for the industry branch. From that we leave
off those systems unrelevant for the company. The rest we rank using again the
opinions of the managers which we have studied and analysed in the stage 3. Then

we can define an objective application map for the future.

In picture 2 there are some examples about applicable systems in each strategic situation in consumer goods business.

PRESENT EDP
(stage 2)

LIST OF APPLICATIONS	EFFECTI-VINESS
Order entry	2
Inventory ch.	4
Invoicing	3

LIST OF EQUIPMENTS	EFFECTI-VINESS
Card readers	0
Teller terminals	4
Mini computer	2

ORGANIZATION OF EDP

- personnel
- centralization
- position of edp-department

RANKING LIST
(stage 3)

Ranking list of the potential opportunities IT has to the business

1
2
3

RESULT
(stage 4)

LIST OF APPLICATIONS	QUALITY DEFINEM.	SCHE-DULE	COSTS
Order entry	60 % of suppliers	9/90	12 000
Inventory contr.	70 % of products	5/91	22000
Invoicing	All account customers	10/91	4000

LIST OF EQUIPMENTS	QUALITY DEFINEM.
Card readers	80 % of shops
Teller terminals	95 % of shops

ORGANIZATION OF EDP

- personnel
- centralization
- position of edp-department

APPLICATION MAP OF THE INDUSTRY

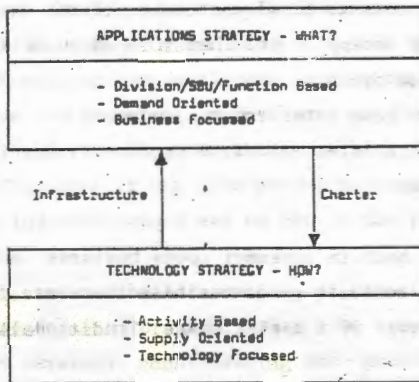|	CL	DIFF.	FOCUS
SUPP-LIERS		• • •	• •
INTER-NAL	•	• •	• •
CUS-TOMERS		•	•

BUSINESS STRATEGY
(stage 1)

Picture 3. ITS formulation.

Now we have an objective application map and the present application map (studied in the stage 2). From the differences between these two maps we can write out the criterias for application development, which means

- order for starting projects
- schedules for projects
- resources needed.

This is illustrated in the picture 3.

In planning there must be a balance between business needs and the means to satisfy these needs. Application portfolio gives the answer to the question WHAT and technology infrastructure gives the answer to the question HOW. These must be planned together like presented in the picture below.[13]

```
        ┌─────────────────────────────────────┐
        │  APPLICATIONS STRATEGY - WHAT?       │
        │                                      │
        │   - Division/SBU/Function Based      │
        │   - Demand Oriented                  │
        │   - Business Focussed                │
        └─────────────────────────────────────┘
            ▲                        │
   Infrastructure              Charter│
            │                        ▼
        ┌─────────────────────────────────────┐
        │  TECHNOLOGY STRATEGY - HOW?          │
        │   - Activity Based                   │
        │   - Supply Oriented                  │
        │   - Technology Focussed              │
        └─────────────────────────────────────┘
```

Picture 4. The balance between demand- and supply-oriented ITS planning.

Strategic decision making is always difficult and has partly a nature of intuition. Therefore the decisions cannot be made by a consultant or a program but by the managers of the company themselves. They are the only persons who are fitted with the culture and knowledge of the company. Assistants - both human and programmed - can help them to plan the decisions and to take the right kinds of matters into consideration. That is why we are building an expert system. Its idea is shortly presented in the next capture.

_____

[13] Earl 1986

5 EXPERT SYSTEM FOR WHOLE SALERS' PLANNING PROCESS

Expert systems (ES) are perhaps the most important part of the research areas of the artificial intelligence. ES:s are so far not been used very largely, but the pressure to adopt the knowledge technigue as a method of developing computer programs is increasing all the time. The main domains of ES:s have been medicine, engineering, chemistry, geology and like in computer sciences always, the defence. During the last years this technigue has been adopted also to business applications.

In our study the domain of ES is the planning process of ITS for whole sale firms. The structural change of whole sale business is rather new matter and not very much discussed in information systems science. Shortly it means that the delivery chains from producers to final customers (firms or consumers) are too long, there are too many steps in it. Therefore whole salers are changing from storehouses to information brokers, who

- deliver orders and money from retailers to producers
- deliver invoices, dispatch notes etc. from producers to retailers
- manage the material flows

This is going to be the trend both in consumer goods business and in industrial products business. In Finnish consumer goods business there are four strong sale groups which have altogether over 90 % market share. Traditionally they have
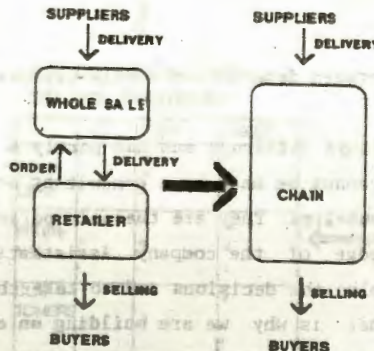
Picture 5. The shift in whole business structure.

been storehouses selling to the retailers of the same group. Now the business between whole salers and retailers is decreasing and there will a chain between producers and comsumers. This shift is illustrated in picture 5.

In industrial products delivery there is the same trend. We have carried out a study in Finnish crane industry and it seemed very obvious that there is one link too much in the chain (the left part in the picture 5). In the future model retailers order via an order system and the products come directly from the factory without any storing. This requires huge information systems in marketing integrated to the advanced production systems so that the principle of JOT-delivery (Just On Time) can be satisfied.

In a "pure model" the objective is to have direct material flows from producers to retailers with no internediate storing. All information may be in electronic form instead of paper. In consumer goods business the producer's sortiment usually is so narrow that no retailer needs a system for ordering just products of that sortiment. Retailers are usually not big enough to build large informa-tion systems. So the builders and maintainers of these systems must be whole salers. The strategy and structure of whole saleing is totally changing. In industrial products business it can also be the producer who builds the systems; this depends on the industry branch and on who is the pioneer in the branch.

So, in that domain we try to build a model of choosing application portfolio and application development program, that is, the ITS which is suitable to support the business strategy considerating the present portfolio. This model we try to program with an ES-generator.

We think an expert system can have several roles in an ITS planning prosess. Some examples is listed in the following:
- it can train the managers concerning strategy problems and concepts
- it can force the managers to formulate the strategy of their own line
- it can force the managers to concentrate on matters which are important but which they otherwise would not think
- it can help the managers to evaluate and rank present applications
- it can help the managers to evaluate and rank opportunities of IT
- it can help the managers to define their information needs

What really are the benefits from using an ES in the planning prosess is a matter we will test after building a prototype of the system.

REFERENCES

Cash, J.I. - Konsynsky, B.R.   IS draws competitive boundaries, Harvard Business Review March-April 1985 (ss.134-142)

Earl, M.J.   Formulating information technology strategies, Research paper, Templeton College, Oxford, 1986

Ives, B. - Learmouth, G.   The information system as a competitive weapon, Communications of ACM, Dec 1984

MacFarlan, F.W.   Information technology changes the way you compete, Harvard Business Review May-June 1984, ss.98-103

MacFarlan, F.W. - McKenney, J.   Corporate information systems management, Dow Jones Irwin, 1983

Parsons, G.L.   Information technology: a new competitive weapon, Sloan Management Review Fall 1983

Porter, M. E.   Competitive advantage, Free Press, 1985

Porter, M. E.   Competitive strategy, Free Press, 1980

Reponen, T.   Tietotekniikka yritysstrategian osana, SITRA A 80, 1987

Reponen, T.   Atk-osaston muuttaminen yritykseksi, Working Paper, Turun kauppakorkeakoulu, 1988

Rockart, J.F. - Bullen, C.V.   A Primer on Critical Success Factors, CISR working papers no 69, 1981

Rockart, J.F. - Treacy, M.E.   The CEO goes On-line, Harvard Business Review, Jan-Feb 1982

Ruohonen Mikko   Managers Perspectives on Information Systems, Proceedings of 11th IRIS Conference, 1988 (forthcoming)

Ruohonen Mikko,   Tietojohtamisen koulutus, Working Paper, Turun kauppakorkeakoulu, 1988

Sääksjärvi, M.   Atk-toiminnan kehittyminen suomalaisissa yrityksissä, Tietojenkäsittelyliitto, 1984

Vepsäläinen, Ari   Maturity beyond integration: New cornerstones of information systems strategy, Working Paper, Helsinki School of Economics, 1986

Appendix 1. Examples of questions in IT opportunities interview form

A. Open questions

1) CUSTOMER RELATIONSHIPS

(customer = consumer)

What kind of goods a typically customer buys?
How much a typically customer buys?
What is the typical profile of our customers? (age, sex, socioeconomic situation, car owner,...)
What the customers like and what they don't like in our shops?
What are the most critical problems in our customer service?

2) INTERNAL EFFICIENCY

(Internal consists of both whole sale and shops)

How the inventory checking is made in shops?
How the sales are reported from the shops?
How the inventory levels are reported from the shops?
Who needs the information from shops?
What information is most needed in chain management?
What information is most needed in shops?
How the data connections between shops and chain management are arranged?
What are the most critical problems in our internal operations?

3) SUPPLIER RELATIONSHIPS

(Supplier = producer)

What is the quantity of foreign suppliers?
What is the quantity of domestic suppliers?
How much the group of suppliers does vary?
How fast can the supplier deliver an order?
How the transport routes are decided?
How the suppliers sell goods to shops?
How the suppliers promotes about their new products?
What are the most critical problems in our supplier relationships?

B. Propositions

Estimate the importance of the matters stated in the following proportions
with the scale

1 worthless
2 worth of observing
3 worth of taking into consideration
4 worth of planning
5 critical to business

1) CUSTOMER RELATIONSHIPS

(customer = consumer)

Customers benefit from the invoicing system of our   1 2 3 4 5
teller terminals.

Customers like the speed of our teller terminals.   1 2 3 4 5

Customers can order goods via our home videotex system.   1 2 3 4 5

Customers can use IT services (bank automates, reservation 1 2 3 4 5
systems,...) in our shops

Customers can get advices and hints about our products   1 2 3 4 5
(recipies, use of chemicals,...) via an information system
in shops

We can use information about the consumer behavior   1 2 3 4 5

We can get information about our customers behavior   1 2 3 4 5
in our shops

We can use the customer information to direct marketing   1 2 3 4 5

2) INTERNAL EFFICIENCY

(Internal consists of both whole sale and shops)

We have shop furnishing planning systems	1 2 3 4 5
The chain management get information about the sales of the shops	1 2 3 4 5
The chain management get information about the profitability of the shops	1 2 3 4 5
The chain management get information about the inventory levels of the shops	1 2 3 4 5
Goods can be transported from a shop to another shop when acutely needed	1 2 3 4 5
The sortiments of the shops can be planned and controlled centralizedly by the chain management	1 2 3 4 5
The wastages of the shops can be controlled	1 2 3 4 5
We have systems for the planning of the personnel use	1 2 3 4 5
We have machine-to-machine connections in invoicing	1 2 3 4 5

3) SUPPLIER RELATIONSHIPS

(Supplier = producer)

We have machine-to-machine connections in paying bills	1 2 3 4 5
We have machine-to-machine connections in order entry system from shops to suppliers	1 2 3 4 5
The order status is available in the order entry system	1 2 3 4 5
Shops get dispatch notes direct from computer to computer	1 2 3 4 5
In shop can orders be entried via videotex system.	1 2 3 4 5
Some products (milk, butter, flour,...) can be delivered automatically by shops' inventory control system when the inventory level has fallen below the signal limit	1 2 3 4 5
Some bulk products can be delivered to shops automatically in standard quantities and periods without any order	1 2 3 4 5
We have an optimizing system for tranport routes	1 2 3 4 5