An Efficiency Evaluation Model of EDI in a Value Added Network: The Influence of User Confidence on Risk

Serge Baile, Professor
Ph.D in Management Information Systems
President of the AIM

Business Administration Institute, IAE-University of Toulouse 1
Research Center on Organizational Development and Information Systems
serge.baile@univ-tlse1.fr

Toulouse Business School-Groupe ESC Toulouse
Financial Research Group
Head of Masters Program in Information Systems Management and Engineering
s.baile@esc-toulouse.fr

Abstract: The evaluation of the performance of information technology and information systems has, over the past three decades, been the object of numerous studies using a wide range of models. Few of them have focused on the study of efficiency, and even fewer still on the development of a specific research model. This paper helps to fill this gap by making a contribution towards formalizing a specific, original theoretical framework and conceptual model, one based on user confidence in ad hoc EDI technology and the risks associated with its use. The model is tested using data obtained from users of a value added network in the car insurance sector. The results of the data analysis, obtained through a series of principal component analysis methods with a Promax rotation and an Amos structural equation analysis, confirm the existence, on the one hand, of an optimal structure of EDI efficiency evaluation factors, and on the other hand, of the relevance of a data model that establishes a hierarchy aimed at explaining risk.

Keywords: IT, EDI, IOIS, Performance, Success, Effectiveness, Confidence, Satisfaction, Risk

Acknowledgements

1 Introduction

Inter-enterprise data interchange networks introduced, in the activities and professions related to car insurance (IARD, healthcare, mechanics, assessors, etc.), a strategic vision essential for effective management in a context of value-added partnerships involving numerous small and medium-sized enterprises (SMEs) [VZ90] [Bai94]. Over the past decade these value added service networks (VASN), operating with no geographical or time constraints, have facilitated the processing of claims and promoted closer relationships between policyholders and service providers. By computerizing the processing of messages specific to the management of car accident claims (quotations, repair orders, billing and payment follow-up, automatic triggering of banking operations, etc.), EDI (1) accelerates administrative transactions and communications between insurers, assessors, garages, car rental companies, etc.; (2) reduces transaction costs; (3) improves the portfolio of add-on services offered to policyholders, thanks to a simplified payment process; (4) improves communication by making it secure and efficient, thanks to the standardization agreed upon by all partners.

These advantages, the outcome of a rational approach to the adoption of EDI, one aimed at performance improvement and organizational efficiency, have been the subject of a voluminous literature that deals largely with the success of this technology in terms of direct and indirect returns and/or strategic benefits [Bak87] [BDS90] [Bo93] [Bai95] [Bai97] [Bai99] [Bai01] [Bai03] [IBD95] [BV96] [BR97] [Ra98] [Ra9] [BT99] [KB00] [CBD01] [Ni02] [Na03] [JP04]. Alongside these benefits, the implementation of EDI can also generate problems to do with security, structure and culture that several researchers qualified from the very beginning as drawbacks and obstacles to its application [Ca90] [C90] [Em90] [Me92][MC93] [SMcG93] [LJ94][Ba99] [Ba01]. Such problems raise the question of the relational nature of transactions, especially in the context of a VASN, where successful transaction automation is largely dependent on mutual trust [Bai99] [Bai01] [Bai03] [Ra98] [HS97].

To maintain and develop this relational dimension within the network, so as to reinforce user confidence in it, constitutes a critical success factor of EDI. Indeed, the organizational efficiency of an IT tool, and especially of the IS it supports, is just as important a factor in gauging the success of EDI as is the assessment of the benefits it procures. The goal of maintaining and developing the relational dimension within the network can only be achieved by taking into account and controlling the various risks EDI introduces into network management practices [WB92] [PR95] [BC96] [Bai98] [RM99] [LH00] [LLK04a).

Although mentioned very often as a reason for the success of EDI, assessment of the organizational efficiency of an EDI-based IS suffers from the lack of both an analytical model and of empirical research. This observation has sparked a research project by a French service provider (d'ARVA, a private operator of a VASN in the mutual insurance sector) on the management of the risks arising from the use of an EDI system. The project, aimed at improving service quality, is based on a deterministic approach to the evaluation of the conditions and factors that would enable the control and reduction of the risks of EDI adoption and use. The objective of this paper is to examine, in the

framework of this approach, the context of the evaluation of organizational efficiency, and to do so through formulating and testing a general model of analysis of the impact of network user confidence on perceived risk. This study contributes to dissociating two levels of efficiency evaluation that have been confused up to now: that of the confidence of EDI users, often assessed in IS research by their satisfaction, from that of the risks inherent in EDI adoption and implementation in the context of a particular inter-organizational information system (IOIS). The paper is organized in four parts. The first presents the principal theoretical bases used; the second formulates a conceptual research model aimed at testing relations of causality between confidence and risk. The third part presents the research field and methodology used, while the fourth concludes the paper with a presentation and discussion of the results obtained from the exploratory factorial analyses and structural equations.

2 Theoretical framework of organizational efficiency with EDI

For a long time EDI has been known for its contributions to the development of large-scale business networks and electronic marketplaces [Ba99], which use it for operational ends (time and cost reduction etc.), and/or tactical ones (control of a market, service quality, etc.). In many business sectors today, one can observe a new orientation of management practices that give pride of place to EDI. It is a proactive, rapid response orientation, and it makes the transmission of information an omnipresent and crucial question for leaders of SMEs, especially in highly competitive sectors subject to strong economic pressure such as transport and automobile repair. It is taken for granted today that one of the advantages of EDI is that it facilitates the globalization of administrative, commercial and financial transactions by encouraging remote exchanges, as is the case between insurance companies, policyholders, assessors, mechanics, banks and competitor companies in the automobile insurance sector.

Although the relationships are fundamentally different in nature *(business versus no-business)*, they are at the origin of a new vision of an extended, relationship-based enterprise. This vision has led to major transformations of relations between partners, as well as to organizational changes, the restructuring of activities, and the overhaul of sectoral and intersectoral processes. The many examples, in France, of networks and electronic marketplaces show that this vision is not an illusion, and that it is a prerequisite for closer collaboration between actors in sectoral and intersectoral value chains, mixing commercial, industrial and administrative relationships.

The research project, of which this study is an extension, aims to bring a new theoretical perspective to the analysis of the success of EDI within these networks and marketplaces. It falls within an environment of existing EDI practices that favor an economic approach consisting in the development of new commercial and corporate networks (an approach that is opposed, in economic theory, to traditional hierarchical structures). This environment is limited to two situations that generally concern the deployment of inter-enterprise information systems that support the practices of EDI.

The first situation, the object of this project, concerns SMEs operating as "value added partners". This model of network architecture, used by service-oriented companies such as Ean-Gencod, d'Arva or Tedeco, is based on the principle of organized cooperation between independent SMEs managing a flow of products or services in a value added chain. The model supports a just-in-time approach: the suppliers upstream must reorganize to ensure the delivery of the products or services within specified time limits. Once just-in-time is a relatively strong constraint in the chain, it leads to periodic and more or less dense relations.

The second situation, the object of work on the success of electronic marketplace use, concerns companies operating on the principle of a "solar organization" of SMEs (producers, suppliers, distributors), ones that serve captive markets or operate in the orbit of major projects or "pivotal" firms (such as the principals in the aeronautics, automobile, IT, and industrial equipment industries). This network architecture model is based on either a policy of subcontracting or on a strategy of sales engineering partnerships. The model still supports the just-in-time method, but often, here, to optimize the management of activities parallel to the production of a finished product. It leads to dense and long-term relationships, once just-in-time is implemented to serve the needs of an integrated management of the solar organization.

In these two situations, the evaluation of the practices and success of IOIS supporting the use of EDI is relevant for senior management, since it can, to a certain extent, justify strategic and organizational development choices, and thus a particular return on EDI investment and budget [BH01] [BH03]. It can also justify incentives to adopt and effectively use EDI (Pi98], as well as justify objective and rational criteria for measuring the performance of this IT tool in organizations that integrate it into their IS [LKL04b]. This evaluation legitimates the attempt, undertaken below, to define a theoretical framework in which the measurement of the efficiency of an EDI-based IS will find its place.

2.1 Theoretical framework for evaluating the success of EDI

The success of EDI falls under a general problematic of performance that involves evaluating not only the advantages (direct, indirect and strategic) of this IT tool, but also the disadvantages (technical, organizational, and cultural) that arise from the difficulties, both internal and external, of integrating EDI and using it effectively in the organization. If the evaluation of the advantages is relatively well known, and is made by using indicators of relative or absolute efficiency [Bai97], that of the obstacles and problems, and thus of the organizational efficiency the IS supports, is much less well-known.

This success is thus, in essence and in the first instance, a result of a dominant rationale for adopting and using EDI [Bai95, p. 36] [KW96] [Ra98] [JP04] when it is a question for a company:

-   from the point of view of its internal development, to pursue a better *organizational efficiency* (e.g. new and direct benefits in the short term resulting from effective EDI

use in a context of improving regular management tasks and, *de facto,* reducing costs);

- from the point of view of its external development, to pursue greater *economic effectiveness* (e.g. new indirect benefits resulting in the medium term from the judicious use of EDI to facilitate priority management processes, such as those aimed at meeting customer needs and speeding up supplier response);
- from the point of view of the projected creation or development of business portfolios, to pursue new strategic capabilities of *organizational innovation and structural transformation* (e.g. longer-term benefits and strategic advantages resulting from an alternative economic development, such as those arising from new markets, business partnerships, and products or services).

[LKL04b] present, on the basis of an inventory of the literature on EDI performance of the last two decades, an interesting summary of 18 measurement items that, using an exploratory factorial analysis, lead to the identification of five factors that confirm this rationale. These are: (1) *competitive advantage* (development of market share, sales, productivity, competitive advantage) (2) *reduction of processing times* (improvement of processes, durations, responses, transactions); (3) *improvement of information quality* (accuracy, control time, speed, transactional relations); (4) *decrease in management accounting costs* (purchasing, transactions, inventory); and (5) *improvement in operational efficiency* (reduction of the cost of labor, work, and customer services). This result, as well as those resulting from more deterministic and econometric approaches to the impact of EDI on performance, proves that there are tangible elements of evaluation, particularly when it is a question of justifying, from a "commercial" point of view, the participation of a company in a network of businesses (as is the case in insurance BtoB) [KS01]. This single evaluation cannot, however, suffice to appreciate the real impact of EDI on the source of organizational performance, namely good EDI practices and appropriate use of this IT tool, leading to real satisfaction in its implementation and effective control of ensuing risks.

In this sense, the success of EDI is also, out of necessity and in the second instance, a product of the drawbacks that it entails and the general shake-up that it can cause. Rare are the studies on the success of EDI which deal with the resolution of problems inherent in (1) a lack of, or poor, EDI planning in the organization; (2) the lack of, or a poor, process of alignment of EDI with strategy; (3) poor control by management and, very often, a total absence of management involvement in the relevant decision-making; (4) the management of change, which is often difficult without outside support and, as a consequence, inadequate stakes-based project management; (5) a lack of, or a poor, estimation of the resulting organizational efficiency, related to the confidence and risks engendered by the use of EDI. It is to this last point, and to an explanation of organizational efficiency, that this paper makes a theoretical contribution.

2.2 Efficiency, confidence and estimation of EDI risk

The efficiency of an IS is based largely on the effective use of the organization's IT resources [O'Br04, p. 27]. This concept was validated very early in social psychology by

the studies of the interpersonal communication process in organizations [RO74] [RO79] [Bai79], as well as by those in the MIS field related to the end user and to the man-machine interaction [Sc7] [Ba85]. These latter studies, identifying the main determinants of the use of a computer system, classify the perceptions, beliefs, and attitudes of users vis-à-vis the technical quality of the system, its performance, and environmental and human factors [Lu74] [Lu75a] [Lu75b]. The beliefs and attitudes of EDI users are thus thought to contribute to increasing the degree of use of this technology. Certain variables characterizing favorable beliefs towards EDI, as was the case for other IT tools, would require that users indicate their degree of satisfaction with the consequences of the use of an IS integrating an EDI application. Other variables, characterizing attitudes, would force users to evaluate, whether positively or not, the consequences or impact of this use.

- The satisfaction variables constitute so many "responses" to the use of an IT tool; they measure beliefs in relation to acceptance of the tool, and more fundamentally, the confidence users have in its use. In the case of an IT communication tool (such as EDI or the Internet) the importance of confidence is based on the potential use of the technology to increase and improve the sharing of information [Ra98]. The confidence in the use of EDI could thus increase the probability, between partners of goodwill, of broadening the scope of information interchange and of exploring mutually beneficial agreements [HS97]. From there, confidence in an EDI-based electronic business partnership would increase the chances of perpetuating the relationship and obtaining the necessary commitment to broaden inter-organizational relations. In this exploratory study of a "community of practices" in the insurance business, involving common values established by a "code of good conduct and common rules", the confidence based on "identification with the profession" (Shapiro *et al.*, 1992) answers as much to the necessity of resolving a common task (dealing with the accident) as to that of dealing with each partner's individual communication specificities introduced by EDI standardization. The choice of the satisfaction variables will be determined through a preliminary analysis of the dual context, that of the VAN (the community) and that of the organizational specificities resulting from EDI.

- The impact variables constitute so many "determinants" of the effective use of an IT tool; they measure attitudes regarding ease of use and, more fundamentally, implementation risks. In the case of EDI, the risks are multiple and are inherent not only in the network infrastructure and the technology, but also in security and in the organization. These risks may be generic (i.e. related to the operational and contractual implementation) or specific (i.e. related to the conditions of operation, supervision and control of the VAN) [RS97]. The risks as a whole are affected by confidence. So, for example, the VAN reinforces its level of security (regarding interconnection problems) by supplying a mailbox service and by instituting "third party confidence" procedures to guarantee data integrity and continuity of data interchange. Similarly, legal responsibility may not be defined clearly in the contract, entailing a risk of breach of contract or simply of conflict between the partners. Finally, we can evoke the risk of a loss of business continuity resulting from the loss of confidence in the services of a VAN, from the accidental or deliberate deletion of messages, from erroneous, non-authenticated or unauthorized transactions, or finally, from the lack of auditing procedures. In fact, here also, the choice of variables, qualifying the risks specific to the VAN concerned by this

study, will be conditioned, on one hand, by the nature of the transactions and, on the other hand, by the occurrence of problems to do with the operation of the network.

The conceptual choices mentioned, first in the theoretical framework of the evaluation of success and then in the examination of the concept of efficiency, lead to the formulation of a general theoretical research model.

2.3 The theoretical model underlying efficiency

This model aims to structure the analytical approach to the efficiency concept of an EDI-based IS. It is adapted from preliminary work that set out to justify the importance of this concept [Bai85], without trying to isolate it from either the general study of IT performance or that of the success of EDI. The model asserts that there is a correlation between the measures of EDI-user confidence in a VAN and the measures of risk linked to its effective use. The premise underlying this theoretical approach maintains that efficiency is multidimensional and must be approached by evaluation considerations that highlight a causal reinforcement between beliefs and attitudes, in the sense of [FA75].
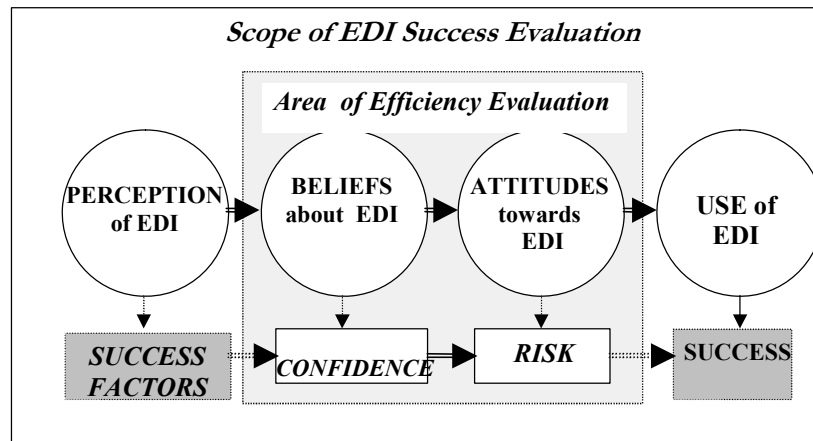

Figure 1: Theoretical framework for the evaluation of organizational efficiency with EDI

3 Conceptual model of efficiency evaluation

The conceptual model of efficiency evaluation is based on a general hypothesis of the influence of user confidence on the risks of EDI use.

3.1 User confidence is a multidimensional efficiency evaluation concept, related to a system of beliefs at once technical, structural, and economic:

- Technical, since the EDI user, client of a VAN, wants a tool that is effective, reliable, secure, compatible with the IT architecture (database, network,

management applications), and capable of adapting to his functional needs through appropriate interfaces;

- Structural, since both the internal and external integration of EDI in the activities of the firm must be optimized, so that its contribution to the development of the organization, to its structure and strategy, meets real needs (improvement of processes, services, etc.) and is consistent with management objectives (improvement of relationships, results, etc.);

- Economic, since the costs generated by the use of EDI (both capital expenditure and operational costs) must not reduce the financial gains (linked in the short term to a better control of costs and thus to an almost immediate increase in margins) and the gains in time (linked in the longer term to an increase in sales and profits derived from better cash management).

Confidence is thus the object of several criteria of user satisfaction, each one being a partial measure of a system of beliefs about EDI:

- Regarding *technical beliefs,* a measure of *confidence in EDI as a support of technology* is the object of a construct measuring **satisfaction with the technology support (SST).** *(N.B. Here, as in all the instances that follow, the labeling system uses the French equivalent of the relevant term).* This construct uses the following four variables:

- **SATIS_SYST** measures the technical quality of the system and of the IT equipment dedicated to the everyday use of EDI.
- **SATIS_IU** measures the quality of the user interface that enables and facilitates the configuration of the EDI system.
- **SATIS_FONC** measures the functional quality of the EDI communication system, from the point of view of its internal integration in the firm's IT system.
- **SATIS_NP** measures the functional quality of the EDI communication system, from the point of view of its external integration (message standards and protocol).

- Regarding *structural beliefs,* two measures of confidence, in EDI as a *support of relationships and communication* in the VAN, on the one hand, and, on the other hand, in EDI as a *support of organizational and strategic development,* are the object of two distinct constructs of satisfaction. The measure of confidence concerning **satisfaction with the communication support (SSC)** uses the following three variables:

- **SATIS_CONT** measures the contractual terms linking the user to the VAN.
- **SATIS_REL** measures the quality of the relations between the user and the VAN.
- **SATIS_INDI** measures the closeness of EDI user behavior to the VAN.

The measure of confidence concerning **satisfaction with EDI as a support of organizational and strategic development (SSS)** uses the following three variables:

- **SATIS_STRAT** measures the contribution of the EDI system to the firm's development strategy and to its competitive positioning objectives.
- **SATIS-STRUC** measures the contribution of the EDI system to the improvement of the organization and to the development needs of the structure and its management system.
- **SATIS_SERV** measures the contribution of the administrative, sales, and financial services of the VAN.

- Regarding *economic beliefs,* a measure of confidence in EDI as a support of business and economic development is the object of a construct measuring **satisfaction with business support (SSA)** using the following two variables:

- **SAT_COUTS** measures the level of costs generated by the use of the EDI system (CAPEX and OPEX).
- **SAT_GAINS** measures the financial gains and the gains in time obtained through the use of EDI.

To summarize, the system of beliefs of EDI users is the object of four independent modes of evaluating confidence in this IT tool. Each mode gives rise to a specific construct aimed at the measurement of the four independent variables of satisfaction (SST, SSC, SSS and SSA) in the EDI risk evaluation model.

3.2 EDI risk is also a multidimensional efficiency evaluation concept derived from the attitudes toward EDI use.

This concept addresses the possible occurrence of events that do not depend exclusively on the will of the users of the VAN, events that may have a negative impact and thus affect efficiency. It involves measuring the level of risk, most of which weigh on the success of an IT project, that may arise from "deviant" behavior. Numerous studies illustrate such behavior [SK85][HPRS93][RKM94][PR95][SW95][RKM94][MKK95] [MKP98][Ra99][RM99]. The studies all agree on the fact that EDI projects entail more risks than other IT projects. These risks are related to both the very adoption of EDI, when the VAN has to persuade partner users to opt for this IT tool, and to its implementation, when it has to convince participants to make optimal use of it. This is sufficient reason to suppose that implementation risk could affect the success of EDI, from the perspective of its advantages, and therefore it needs to be managed well.

The measurement of EDI risk is the object, in this study, of a construct that limits its investigation to the everyday use of EDI. Adoption risk is thus left aside, since users' decision to adopt EDI is, for this VAN, taken for granted by the mutual insurance companies who, as veritable principals, are the hub of the network. Only the management of "implementation risk" [RM99] appears to be determinant of a better grasp of the technical quality of the system proposed by the VAN, of a deterioration in

service quality, and of a rupture in relations between users due to inadequate economic performance. The measurement of this RISK factor is carried out using the following variables, chosen by the managers of the VAN under study:

- **RISQ_CONF** measures the possibility of conflict arising between the user and the value added services provider.
- **RISQ_RUPT** measures the possibility of a breach of contract between business partners.
- **RISQ_RC** measures the possibility of a response from competitors to a major dysfunction of the system (to EDI ineffectiveness).
- **RISQ_R0** measures the possibility of organizational changes and changes in management processes, difficult to control because of EDI use.
- **RISQ_RI** measures the possibility of problems arising in the organizational and technical integration of the system into everyday activities.
- **RISQ_TEC** measures the possibility of technical malfunctions, of an unfavorable evolution of the system and its technical capacities, relative to the expectations of the firm.
- **RIS_INC** measures the possibility of an increase in uncertainty regarding the technical control of the system and its technological evolution.
- **RISQ_LU1** measures the possibility of a limitation in the use of the system due to an unfavorable evolution of its technical capacity and expected performance.
- **RISQ_LU2** measures the possibility of a limitation in use of the system due to a reduction in interest on the part of direct users, or to their negative response to it.

3.3 The conceptual model and research hypotheses

The general working hypothesis that formulates the influence of user confidence on the risks of EDI use is based on a model of dependence, the structure of which is given in Figure 2. This structure concerns three interdependent levels of efficiency evaluation:

- An entrance level, with the two exogenous variables of satisfaction in the technology support (SST) and in the business support (SSA).
- An intermediate level, with the two exogenous variables of satisfaction in the communication support (SSC) and in the support of organizational and strategic development (SSS). Note that these two variables are endogenous vis à vis the SST and SSA variables.
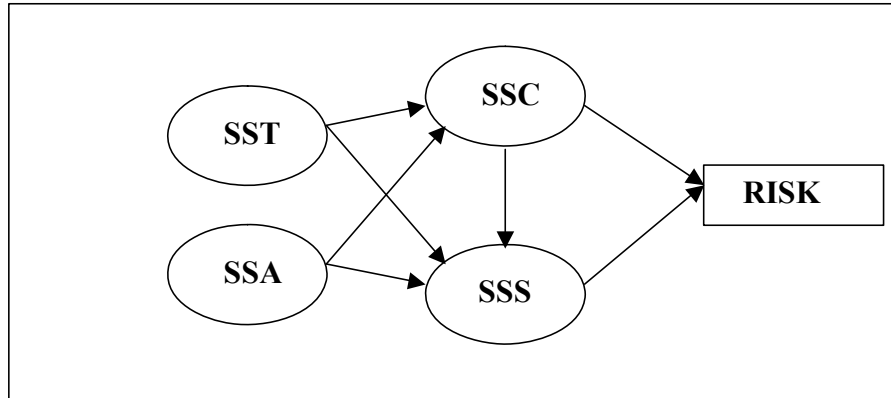- An exit level concerning RISK, as an endogenous variable.

Figure 2: Conceptual model of efficiency

This structure implicitly assumes that structural beliefs, concerning the grasp of the EDI development and communication supports, are affected by the technical and business beliefs. In other words, confidence in the realization of organizational development objectives (relational and strategic) is dependent on confidence in the realization of objectives to do with achieving a certain technological and business standard. This premise is derived from the principle of aligning user satisfaction based on a finality of change with user satisfaction based on objectives.

The research hypotheses that underlie this proposition [Bac89] are formulated in such a way as to verify, firstly, the structure and interdependence of the variables in the model, and secondly, the structure of their direct and indirect relations. The aim of the first hypothesis is thus descriptive, while that of the second is explanatory.

> H1: *The general efficiency of an EDI system can be evaluated using interdependent variables that measure user satisfaction in the technological, business, strategic, and communication supports, as well as the perceived risk.*

This hypothesis is aimed at verifying the existence of a "cognitive map" of the satisfaction and risk concepts, which until now have never been the object of an interdependence analysis aimed at developing a simple structure. If this hypothesis is validated, the results would then complement the findings of certain studies (LLK 04a) that set out to structure the analysis of just the advantages alone.

> H2: *The efficiency of an EDI system, measured in terms of perceived risk, is structurally dependent on the efficiency of its use, and of its technological, business, strategic and communication support.*

This hypothesis is aimed at verifying the existence of *direct and indirect causalities* between efficiency variables measuring a process of EDI use in a VAN context. If the hypothesis of the existence of such a structure of dependencies between variables is verified, the results would then reinforce the findings of the numerous studies that set out to understand the complex mechanism of IT performance evaluation [Na03] [Bai01]

[Bai03] [FP99], and that, up to now, have only very partially addressed the problematic of IT efficiency, without ever referring to an explanatory model.

4 The research field and methodology

Such a research objective had to use a sectoral field of study, one where EDI is used in a context of long-term and not episodic business relations |Bai97], so that it would be worthwhile to undertake an evaluation of its efficiency, since it would be used by SMEs within a VAN (d'ARVA for the French insurance companies). The car repair sector and a "DARVA" VAN, specialized in transactions between insurance companies and a wide variety of partners, enabled the conduct of a study that was close to users and the problems they might encounter in their daily use of EDI. This network therefore deserves a short description that will facilitate understanding of its practices and the issues at stake. This objective, from the viewpoint of empirical research, also had to use a series of methods that need to be justified, without necessarily describing them, in a way that is consistent with the hypotheses put forth.

4.1 The research field – the d'ARVA VAN

4.1.1. General presentation of the VAN

A pioneer and specialist in the exchanges between the various actors in accident management, d'ARVA was founded in 1988 with the objective of developing electronic data interchange in the insurance sector. Its first vocation was to contribute to the simplification of relations between the computer systems of insurance companies and those of their partners and suppliers with whom they regularly exchange data in the automobile, fire, healthcare and general risk sectors.

Today, d'ARVA's experience together with its expertise in information processing technologies enables it to offer a wide range of innovative online services. Guaranteeing the integrity of the messages conveyed, the company plays a major role today as a federator, around common standards and processes, in insurance claims management. d'ARVA's shareholders are the major players in the insurance, appraisal, and car distribution and repair sectors:

- *Insurers:* GMF, MAAF, MACIF, MATMUT

- *Automobile appraisers:* CSNEAMI (Chambre Syndicale Nationale des Experts en Automobile et Matériel Industriel), CSNEAF (Chambre Syndicale Nationale des Experts Automobiles de France).

- *Bodywork / Car repair specialists:* AXIAL, FNA, CNPA, GNCR.

- *Automobile distributors:* FEDA (Fédération des Syndicats de la Distribution Automobile).

4.1.2. The stakes and objectives

The main objectives of the VAN have been achieved today for the automobile sector. These objectives concern:

- The acceleration of the processing of accident claims and the reimbursement of healthcare costs, and thus the acceleration of relationship flows and transactions between insurers, assessors, garages, car rental firms, etc.

- The reduction of costs: automated processing of incoming data and statistical monitoring of the cost of car repairs.

- The portfolio of add-on services offered to policyholders, expressed via a relationship between insurers and garages or insurers and healthcare professionals: the insurer directly settles the bill for repairs or healthcare.

- Thanks to the ARCAUTO standard developed by d'ARVA and elaborated in cooperation with all car repair partners, all actors can communicate securely and effectively. ARCAUTO enables the easy exchange of documents between partners irrespective of computer system compatibility.

- d'ARVA also develops services based on the Internet support.

To sum up, EDI activity constitutes 84 % of the total activity of the VAN, and the volume of transactions is in constant progression (see Figure 3 below).
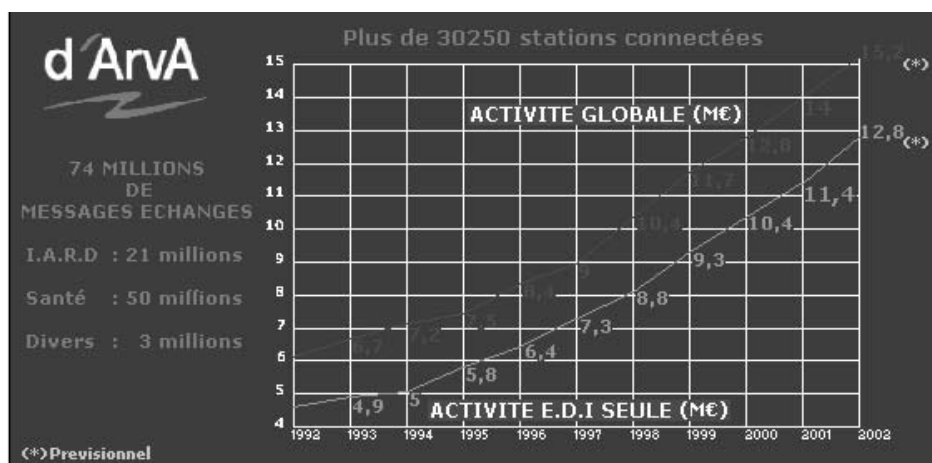

Figure 3: Evolution of the VAN's activity (e.g. www.darva.com)

4.1.3. Management of car accident claims by the d'ARVA network

All d'ARVA's services have been designed to speed up and facilitate the processing of car accident claims:

- *DIPREF:* This service connects the accident victim to the relevant police station, in the context of requests for identification of the owners of cars involved in traffic accidents or inquiries regarding the effective ownership of the car.

- *ARCHEDI:* Messages exchanged between partners are archived for six years, including easy online access for one year.

- *ARGOS:* For information such as "written off as a wreck" and declarations of car theft, this service assures the secure and standardized exchange of messages.

- *BROKEN WINDOWS:* This service enables the reception of invoice messages specific to broken windows from garages and networks of professionals.

- *EAD:* d'ARVA's EAD standard guarantees the interoperability of certified software solutions for assessors, garages, car rental firms, etc.

- *COURTAGE:* This service for brokers enables the management of car accident claims. Brokers are delegated full authority for all procedures concerning the compensation of the policyholder. The service enables actors to use exchange media such as the fax, post, and email.

Indeed, d'ARVA has defined an EDI standard that enables the exchange of standardized messages between insurers, assessors, and garages. The main standardized messages exchanged are mission orders, assessor reports, remote appraisal, invoices, assumption of costs, repair estimates and invoices, payment notices and EAD, as detailed below.

- **Mission orders:** The insurance company mandates an assessor and a garage to manage the accident.

- **Assessors reports:** One or more exchanges between the assessor and the garage until a quotation is agreed upon (once the vehicle has been stripped down the garage can submit new operations to the assessor for billing).

- **Remote appraisal:** During the appraisal, the assessor and the garage together determine the scope of the repairs and the man hours of labor required, and the nature of the operation. They both can use an Internet database listing the price for every part and model of vehicle.

- **Invoices**

- **Assumption of costs:** Provides a guarantee to the garage that it will be paid by the insurance company and not the client.

- **Repair estimates and invoices**

- **Payment notices**

In addition, d'ARVA offers other services designed to speed up and facilitate the processing of claims:

- connection to police stations in response to requests for identification of vehicle owners

- archiving of messages exchanged between partners

- specific messages for broken windows

- remote appraisal (enables time saving and cost reduction).

In the case of car theft, the ARCAUTO service automatically assures relations with ARGOS. The service is available to insurance companies that have paid a one-time registration fee, and to assessors and garages that use management software certified by d'ARVA.

To reduce problems of technical adaptation (standards and protocols) arising from the numerous computer systems that have to communicate with each other, d'ARVA developed a software program called *EDITEL Multimédia*. EDITEL establishes communications for data interchange, as well as for control and codification. d'ARVA provides the EDITEL program which handles the remote transmissions. The exchange fee for this service includes the costs of archiving, quality control, and assistance. EDI itself is billed at a flat rate for each automobile accident claims dossier, irrespective of the number of messages exchanged per claim.

4.1.4. The benefits of the d'ARVA management system

The benefits concern the following elements.

- **An increase in the volume of business.** The garage that joins the d'ARVA network enjoys privileged relations with insurance companies (AGPM-MEPM, GMF, MAAF, MACIF, MACSF, MAIF, MMA).

- **A saving of time.** Instant, real-time information speeds up the processing of claims.

- **A reduction in management costs.** Standardization and automated processing of incoming data mean that data are keyed into the system only once, eliminating multiple data capture as well as the need for paper, envelopes, and stamps.

- **A gain in cash.** This is achieved thanks to a shorter collection period. This is a particularly important criterion in the evaluation of economic efficiency. Garages have a structurally negative cash position, which constitutes a significant financial constraint. Their suppliers, mainly car dealers, grant them very short payment periods, typically no more than 30 days, while the payment terms of the insurers allow them to take a relatively long time to pay the garages. These long payment times are partially due to slow information processing. For example, when the garage sends a new appraisal report after the car has been stripped down, the response from the assessor can take over a week.

- **A control of repair cost statistics.** This statistical information enables the garage to better negotiate prices with potential clients.

4.2 Research methodology

4.2.1. The sample

The field of investigation for this research study is that of the use of EDI by a sample of 82 car repair specialists (body shops and garages). These SMEs are participants in the VAN described above, and use EDI and associated services in a unique transaction format (as described in the flow chart in Appendix 1). The evaluation of EDI use was performed in collaboration with the VAN development team in two distinct phases over a 3-month period. A questionnaire was designed to evaluate, within the framework of the research project, the "critical success factors (CSFs) of the VAN and its performance". The first phase, aimed at exploring the subject and gauging its interest, was conducted using semi-structured interviews with EDI expert-analysts and users. It focused on identifying and separating out EDI implementation problems and best practices in services. This auditing phase formalized a first approach to the evaluation of EDI use in the VAN, and enabled the formalization of "an analysis of content" for the purpose of being structured and used, via a questionnaire, in a second phase that would address a representative sample of companies in the VAN. This second phase, characterized by field work, made use of a questionnaire structured in three parts (identification of the company, evaluation of the CSFs, and performance measurement). The questionnaire was addressed to 140 selected companies in the VAN (according to their size and frequency of EDI use relative to their volume of activity). The near-60% response rate reflects the quality of the interviews, the interest the VAN took in this study, and the contribution expected of the research work conducted in collaboration with the network.

Only that part of the questionnaire that deals with the problematic addressed in this paper is utilized here. The cognitive properties of the constructs are measured, on one hand, using four differential terms that enable one to capture user perceptions of the attributes measuring the beliefs concerning confidence in the EDI support, and on the other hand, using differential terms measuring attitudes toward the perceived risk in the implementation of EDI. The variables of each of these five constructs are measured using 7-point Lickert scales – the direction or progression of some of them had to be "reversed" to account for the perceptions collected during the auditing phase. For example, the perception of the cost advantage, in fact a disadvantage, is reversed in its measurement, relative to the real advantage of financial and time gains.

4.2.2. The data analysis method

The data analysis method chosen led to the successive use of two types of method aimed at testing the two research hypotheses. The choice of the first responds to the imperative of empirically validating the research constructs or variables, so as to test the hypothesis (H1) of the existence of the cognitive structure of efficiency variables defined in the conceptual model. This verification was performed using a dual analysis: first, that of a convergent and discriminant validation of the constructs; and second, that of their internal validity. The first was done using a principal component analysis form of factor analysis (PCAFA) on the 210 linear correlations [21 x [21-1]/2], between the variables measuring the four satisfactions and the risk. The signification at the risk threshold of 5% for 70% of them expresses the existence of a cognitive structure of perceptions and attitudes requiring a factorization for its identification. The factorization uses a principal component factorial analysis that rejects the components (factors) whose own values are less than 1. The discriminant validity is performed here using Kaiser criteria. The criterion for convergent validity entails the selection, for the examination of the extracted factors, of only the original variables whose factor-loading is greater than 0.5 [FD96]. The extracted factors are subjected to an oblique rotation using the PROMAX criterion. This rotation method is preferred to orthogonal rotation, since nothing justifies, in this exploratory (and not "confirmatory") analysis, to argue in terms of a simple structure: certain extracted factors, although distinct, could be linked to one and the same concept [EPR93, p. 374]. For this reason, the extracted factors are correlated with each other. Finally, the projections of each observation onto each extracted factor (score factors) are used to test the second hypothesis (H2) – the normal distribution of each of them enables the reduction of certain statistical biases. The second analysis, testing the internal validity of the constructs of each variable, was performed using the Cronbach alpha coefficient. The validity of the construct is affirmed for coefficients whose alpha is greater than 0.70 [Nu78].

The choice of the second type of method has to do a dual objective. Firstly, relative to the test of the general hypothesis H2, to validate the global internal structure of the research model. Secondly, in the hypotheses adjacent to and implicit in this first validation, to validate the existence of significant direct and indirect dependencies between the variables of the model, thus enabling the validation a "cognitive arborescence" between them. The evaluation and the test of the causality model is done in three phases—identification, estimation, and goodness of fit, then the significance of the different parameters is measured.

- The identification of a causal model, with its 5 variables, consists in verifying whether the system of equations that characterizes it has several solutions; if so, the model is said to be "over-identified". It then has a number of degrees of freedom equal to the difference between the number of elements in the correlation matrix and the number of parameters to be estimated. AMOS verifies that a model is indeed over-identified, by comparing the number of elements in the matrix, equal to 10 in this study (5x4/2), to the number of parameters estimated. The test of a model only makes sense in a situation of over-identification.

- The estimation of parameters is done in an iterative way using the method of maximum similarity, and the use of a test of χ^2, which enables the testing of the null hypothesis that the observed data are linked by the relations specified in the model. This evaluation is performed by taking into account, on the one hand, a level of signification of the test greater than 5% (the less significant the test, the more relevant the data to the specified model), and, on the other hand, the ratio of χ^2 relative to its degree of freedom, which must not exceed 3 [PP-S91].

- The goodness of fit of the model to the empirical data uses a certain number of statistical indices, including those proposed by [JS89], the χ^2/ddl, the GFI (*Goodness of Fit Index*), the AGFI (*Adjusted Goodness of Fit Index*), the PGFI (*Parsimony Goodness of Fit Index*), the [MJDABS89], and the RMR (*Root Mean Square Residual*). The ratio (χ^2/ddl) must not be greater than 5 for a model to be considered reliable. The other indices are to be brought towards 1, by similarity to the criterion of "explained variance" [EPR93]: for complex models, such as that proposed in this study, values between .7 and .8 are fully acceptable [IR99]. Values greater than .9 express a good fit between the model and the data. Finally, the RMR values must not exceed 10% [AW00]. This criterion measures the extent of the "residues", i.e. the variance between the values predicted by the model and the data, and must therefore be interpreted as an influence of factors not taken into account by the model.

- The signification of the model's parameters is determined by a test of their estimator. The most frequently used criterion is that of the Student T test and its probability, which determines whether the parameter is not null statistically. The risk of error is fixed in this study at the threshold of 5%. For the purpose of validating the cognitive structure of efficiency, only the exogenous variables in the model whose risk is below this threshold are included in the arborescence. Each

exogenous variable in the model is also the object of a determination test of its explained variance (R²). The network of relations between variables thus established can then enable the determination of the direct and indirect paths of influence between the variables in the model considered essential to predicting decision-making performance. The standardized weightings of these effects are provided by the output statements of the AMOS 4.0 [AW00] software program.

5 Results and discussion

Application of the data analysis methods produced two types of results. The first concerns the validation of the structure of the variables in the model and the test of H1; the second concerns the validation of the model's internal structure and the test of H2.

5.2 The tests of the validity of the structure of the efficiency variables

PCAFA performed with a PROMAX rotation on all 21 original variables of efficiency measurement (9 for perceived risk and 12 for user satisfaction) produces a factorial solution of 5 factors that explain 75% of the variance, while maintaining for each variable a very satisfactory quality of representation (>.60). This solution restores the 5 constructs of the study, with high loadings (close to or greater than .70), detailed below.

- The first is that of RISK (with **42.82%** of explained variance). Risk is thus restored by the 9 original variables with a high positive contribution (> .72) from each of them.

- The second is that of SSC (with **11.87%** of explained variance). Confidence in the communication system is restored by the three original variables, with a high positive contribution from each of them (> .90), and by the (SATIS_NP) variable that measures the functional quality of the communication system (the SST construct).

- The third is that of SST (with **8.74%** of explained variance). Confidence in the technology support is restored by the four original variables, with a high contribution (> .80) from the technical variables (SATIS_SYST, SATIS_IU and SATIS_FONC), and a high contribution (.73) from the SATIS_NP variable that is shared with the SSC explanation.

- The fourth is that of SSS (with **6.61%** of explained variance). Confidence in the development and strategy support is restored by the three original variables, with a high contribution (> .83) from each of them.

- The fifth is that of SSA (with **5.01%** of explained variance). Confidence in the business support is restored by the two original variables, with a very high contribution (> .94) from each of them.

These results reinforce the first two tests of convergent and discriminant validity of the five constructs used to measure the conceptual research model. Two comments are called for here. The first concerns the high positive influence of the SATIS_NP variable on the SSC and SST factors. This can be explained by the semantic formulation of the question, which considers at once a technical aspect of EDI support (external integration with the communication standards and protocols), and a more functional aspect (that of the quality of the communication system as such). The second concerns the positive correlation of the SATIS_COUTS variable with that of SSA. This is explained by the inverted scale. In fact, had this scale not been inverted this correlation would have been negative, while remaining high.

The third test, that of the reliability of the constructs, produces very high alpha Cronbach values for the RISK scale (.936), the SSC (.918), the SST (.843), and the SSA (.885), and adequate values for SSS (.746). For the scales designed specifically for this empirical research, these values are fully acceptable and are much higher than the value of .70 usually considered acceptable.

To summarize, the results of these three tests of validity confirm, with strong evidence, the quality of the measurement system of EDI organizational efficiency and that of its different constructs. Two complementary analyses of these results, however, need to be performed. The first concerns the strong determinism of risk in this model: with a percentage of explained variance markedly higher than that for confidence (57%), the evaluation of risk in the study of efficiency appears to be essential. This result, never identified in previous studies, confirms that this factor, in the cognitive map of the evaluation of the success of EDI use, occupies an important position that merits an explanation in and of itself. The second concerns the lack of correlation (or only barely significant correlation) between SSA, risk, and the other three confidence factors (see the matrix in Appendix 4.2.1) – due to the PROMAX rotation method used in the PCAFA. This result would tend to show that the "support of business development EDI vision" in the VAN does not meet the expectations of users.

5.3 The test of the structure of the EDI efficiency model

This test is performed in two successive steps, aimed first at validating the assumed fit between the structural model and the data, and then testing the partial hypotheses that support the linear relations between RISK (final endogenous variable), SSC and SSS (intermediate endogenous variables but exogenous vis-à-vis risk), with SST and SSA (exogenous variables). The model tested against the data, presented in Figure 2 in the conceptual framework, suggests that the interdependencies between the EDI efficiency variables are established by a causal—but also hierarchical—structure of the variables [FD96]. It is to this dual objective that the results of the use of the structural equation method contribute.

5.3.1. Validation of the internal structure of the model

The validation of this structure is an essential precondition for justifying the general network of linear relations between the endogenous and exogenous variables of the model as a whole. The validation process follows the phases described in §. 422. The upper section provides the calculation of the main fit indices, while the lower section shows that of the determination coefficients (R^2) of each endogenous variable. Analysis of the accuracy indices shows the following points.

⇨ The causal model is over-identified with a positive "df" equal to 3 (number of moments = 15; number of estimated parameters = 12). These conditions of adjustment to the data (using the maximum similarity method) are respected on the whole: the risk affecting the χ^2 (3.28) is higher than 5% (35.1%), the value of χ^2/dll (1.09) is much lower than 3. **The hypothesis HG2 of a linear structure of causal relations is thus, on the whole, confirmed.**

⇨ The values of the model's precision indices, such as those of the coefficients GFI (.984), AGFI (0.919), and NFI (0.966), are much higher than the norms for exploratory research (§. 422). These values express a very good fit and reinforce the hypothesis of the existence of a structure. The coefficients RMR (4.5%) and RMSA (3.4%) are much lower than the maximum of 10% usually tolerated, and confirm **the high explanatory capacity of the model** (given the negligible effect of the residues).

⇨ The analysis of the determination coefficients of the endogenous variables shows that the explained variance (R^2) of each endogenous variable (RISK, SSS, and SSC) is significant (at the threshold $\alpha < .000$) of the direct effects of the exogenous variables (SST and SSA) as a whole. The relevance of the general theoretical model is confirmed, and the partial hypothesis of **linear relations of direct causality** between the variables is confirmed.

To conclude, the causal structure of the conceptual model is confirmed by both the quality of the reliability indices adopted and by the accuracy of the explanation of its endogenous variables that measure, first, risk, and second, confidence in the communication support (SSC) and in the organizational development support (SSS). This first step, in the following section, identifies the optimal direct and indirect relations between the variables that govern the structure.

Indices	Model
Adjusted RMR	4.5 %
χ^2	3.278
Prob (χ^2)	0.351
χ^2/ddl	1.093
NFI	0.966
GFI	0,.984
AGFI	0.919
PGFI	0.197
Det. Coef. R²	(%)
RISK	31.2 %***
SSS	25.7 %***
SSC	36.7 %***
(***) α < .001	

Table 1: The accuracy and determination indices of the model

5.2.2. Validation of the dependencies, establishing a hierarchy of the variables

The validation of the dependencies is determined by the test of the direct dependencies between variables, such as described by the conceptual model, and weighted by the standard regression coefficients (Figure 4). This first validation, which endeavors to justify the sole significant paths between the three levels of the model, is complemented by a study of the indirect paths, which aims to justify possible non-causality.

⇨ The test of direct dependencies between variables of the model :

- Only dependency coefficients between SSA and SSS (.114) and between SSA and SSC (.14) are non-significant (α>5%). There is no direct influence of confidence in EDI business support and confidence in the communication and organizational supports.

- The dependency coefficients between SST and SSC (.589) and between SST and SSS (.248) are significant. Confidence in the technical support positively impacts confidence in the communication and development supports.
- The dependency coefficients between SSS and RISK (.271) and between SSC and RISK (.380) are very significant ($\alpha < .000$). The perceived risk is thus positively influenced by confidence in the communication and development supports.
- The dependency coefficient between SSC and SSS (.30) is significant at risk $\alpha < 1\%$, and expresses the positive influence of confidence in the communication support on confidence in the development support

Beliefs about EDI as a technology are, without doubt, important in evaluating the efficiency of this IT tool. These beliefs determine, of course, confidence in its use technically, but also reinforce certain beliefs at the origin of confidence in the technological medium of communication and facilitator of organizational and strategic development. These beliefs are themselves at the origin of an effective grasp of the risks of EDI use, and could facilitate the attitudes of users towards it. Thus, to conclude the examination of these direct dependencies, confidence in the structural support of EDI, through its two interdependent dimensions, is a "cognitive pivot" of efficiency evaluation. It is, indeed, at the crossroads of the technical evaluation of EDI and the risks its use entails.

$\Rightarrow$ The study of the indirect dependencies and associated paths :

This study focuses, firstly, on the indirect dependencies of the SST variable on RISK, via the variables SSC and SSS at the intermediate level of the model, and secondly, on the one indirect dependence of SSC on risk, via SSS, which is due to the existence of a strong effect of SSC on SSS. The explanation of the RISK variations is in this sense linked to the hierarchical structure of the exogenous variables of the model, and to the existence of a hypothetical path validated beforehand by significant direct effects. This must, however, be verified by an analysis of non causalities. Regarding the influence of SST on RISK, two path must be analyzed:

- The indirect path between SST and SSS introduces SSC as a hierarchically intermediate variable, with a high indirect effect (.174), expressing a moderate influence of confidence in the technological support on confidence in development support, via confidence in the communication support. The total effect of SST on SSS (.422), equal to the sum of its direct effect (.248) and its indirect effect (.174), is to be compared to the correlation coefficient (.464) to reveal the very low non-causality (.042). Thus, to summarize, the link between confidence in the technological support and confidence in the organizational and strategic development support is 91% explained by this structural model.

- The indirect paths between SST and RISK introduce, on the one hand, SSC, and on the other hand, SSC and SSS, as hierarchically intermediate variables, with a very high global indirect effect (.339), expressing a very strong influence of confidence in the technological support on risk, via the intermediate structural level of the model. The total effect of SST on risk, equal to the indirect effects alone, is to be compared to the

correlation (.455) to reveal a low non-causality (.116). The link between confidence in the technological support and risk is 75% explained. It must be emphasized that the efficiency of this link could be improved by the introduction of a direct causal relation between SST and RISK. After simulation, the direct effect produced (.179) (significant at $\alpha<.10$), added to a significantly lower indirect global effect (.271), gives a total effect (.450) that, compared to the correlation (.455), would give a practically null non-causality. In conclusion, it is proven, from these two viewpoints, that the influence of confidence in technology on perceived risk is indeed real.

Concerning the influence of SSC on RISK:

- The only indirect path is that which introduces SSS, as an intermediate variable but of the same structural level, with a relatively weak effect (.08) compared to the direct effect (.380). The total effect of SSC (.388) is to be compared to the correlation (.508), to yield a weak non-causality (.12). Even though the efficiency of this link is rather high (76 %), it remains reasonable to conclude in the relative inexistence of the sole indirect effect of confidence in the communication support on perceived RISK. This confidence directly affects the perceived RISK.
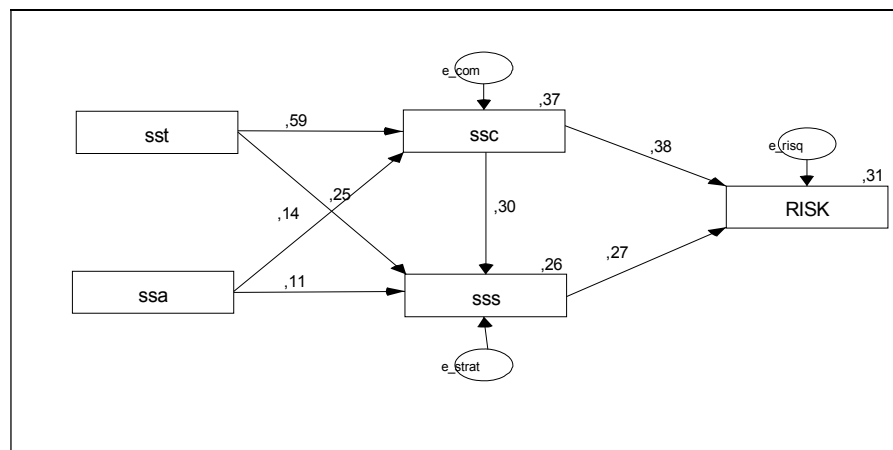

Figure 4: Graph of the dependencies

6 Conclusion

Even though numerous studies have dealt with the success of EDI, reflecting the performance of this IT tool in the business world (mainly in the domain of the improvement of marketing and sales relations) [Bai01], few studies have endeavored to distinguish the evaluation of its effectiveness from that of its efficiency. This remark is not specific to EDI, or to the IOIS that it supports, but has been a recurrent one over the past three decades. Indeed, once it was realized that the success of IT tools was not

intrinsic but rather resided in how they are used, and that the use of IS had more to do with, firstly, the determination of organizations to develop in order to adapt to changes in their environment [Lu75a][CM86][KSG04], and secondly, with the will of senior management to get involved in choices of management and organizational models that emphasize their capacity to process information, to innovate, and to be sufficiently flexible to adapt to their market.

Thus, the evaluation of the efficiency of IT supports, and more generally of IS—whether in the domain of transactional IT, decision support, knowledge management, or interpersonal or inter-organizational communication—has become a research imperative in IS and auditing, if not in control, for companies that have invested in these resources and are not able to evaluate the real return on their investment.

 - From the viewpoint of research work, this evaluation had been marked by a growing interest in "user satisfaction", mainly in the domains of (1) End User Computing and user-friendly interfaces design (satisfaction here is characterized, according to [DT88, p. 261], as "an affective attitude towards a specific computer application, developed by someone who interacts directly with it"); (2) information use (where the user believes that the use of the IS meets his information needs); and (3) the task-technology fit (where the IT and the associated services are assumed to meet the requirements of an activity).

Few research efforts have been devoted to this evaluation process, to its origins and mechanisms [KSG04], even though numerous reference models have used the concept for a long time in order to grasp the success of IS/IT [DMcL03]. In the specific domain of IOIS and EDI, the majority of the contributions on success have been the object of numerous evaluations of effectiveness in terms of tangible and intangible benefits [BT99] [LLK04]. Efficiency does not seem to have been a major concern, even if EDI is at the origin of many problems of adoption and especially implementation. It is thus interesting, if not important, to have succeeded in devoting an empirical study to an evaluation of EDI efficiency, by treating this problematic from the perspective of a contribution to the analysis of the confidence and satisfaction of EDI users and of implementation risk. The explanatory validity of the model contributes, in this sense and in the first place, to extending the field of theoretical investigations in the domain of *task-EDI technology fit.* The concepts dealt with and the results obtained, distinguishing beliefs from attitudes, reaffirms the necessity of separating, in an evaluation, that which pertains to confidence (i.e. intentions for use) from that which has to do with risk (i.e. the attitudes produced by this use). The generalization of such an evaluation to other contexts of EDI or other IT implementation is desirable in the perspective of a confirmation of such a determinist model, but it would need to be adapted to the specificities of the technology, the task, and the activities. The descriptive validity of the model contributes, in the second place, to justifying the multidimensional structure of efficiency, by enabling the establishment of a cognitive hierarchy of the main EDI critical success factors. The results support Delone and McLean's [DMcL03, p. 27] suggestion that "*the selection of the dimensions and measures of success of an IS should be contingent on the research objectives and on the context of empirical investigations, but only when this is made possible by testable and validated constructs*". The

generalization of the results concerning the conception and the validity of the constructs could thus only be possible, for the case of EDI, in research that concerns similar VANs.

- From the viewpoint of assistance to companies, this study fundamentally enables one to argue in favor of the evaluation of IT efficiency, while continuing to evaluate its effectiveness. It is proven, by the results obtained for EDI in a VAN that was the object of field research, that efficiency (evaluated first in terms of risk, then in terms of confidence) has more to do with user beliefs and attitudes in relation to "effective use" (i.e. a satisfactory use of the technology, of its inter-enterprise communication and organizational development support, and of an appropriate management of the risks of use) than with a satisfactory economic evaluation. This conclusion is only applicable to a VAN that has been the object of field work, and probably cannot be generalized to other EDI networks. The specificities of this VAN, particular to the mutual insurance sector and to small companies subject to a very particular services offer) does, indeed, limit the scope of this judgment. The measure of this efficiency finally remains for the VAN a means to audit and control service consumption activities, and thus to bring them up to standard. The "cognitive map of factors" that this evaluation offers serves as a guarantee of user perceptions. In this sense, this map becomes a veritable problem-solving and decision-support tool for VAN managers.

References

[AW00] Arbuckle, J.L.; Wothke, J.L.: *AMOS 4.0 User's Guide*, Chicago: SmallWaters , Corp.-SPSS Inc., 2000.

[Bai79] Baile, S. : L'influence des Facteurs de Composition et de Fonctionnement des Petits Groupes sur l'Efficacité de leurs Décisions - Une contribution à l'Etude de la Performance des Groupes en Gestion des Entreprises. Thèse de Doctorat de 3ème cycle en Sciences de Gestion, IAE-IEC, Université de Grenoble 2, 1979.

[Bai85] Baile, S. : L'influence des Facteurs de Personnalités du décideur sur l'Interaction Homme-Machine et l'Efficacité des Décisions - Une contribution à l'Etude de la Performance des Systèmes Interactifs d'Aide à la Décision en Gestion. Thèse de Doctorat d'Etat en Sciences de Gestion, IAE, Université de Montpellier 2, 1985.

[Bai94] Baile, S. : "L'EDI dans l'assurance - une forme nouvelle de management et de gestion des ressources humaines," *1er Forum des Technologies de l'Assurance. CAPA*, Paris, Palais des Congrès, 2-4 mars 1994.

[Bai94] Baile, S. : "Bénéfices et avantages compétitifs des échanges de données informatisés pour les PME-PMI," 39th International Conference in Small Business, Strasbourg, juin 1994, pp. 11628 *(prix spécial du Jury de l'International Council of Small Business)*.

[Bai95] Baile, S. : "Bénéfices et avantages compétitifs des échanges de données informatiques pour les PME-PMI", *Revue Internationale PME*, Vol. 8, N° 2, 1995 p.7-47.

[BC96] Baile, S. ; Castex, Y. : "Les Stratégies d'influence et les relations de pouvoir au sein des réseaux concurrentes de la grande distribution : l'apport des technologies de l'Information et de l'EDI," Actes du 2ème CIMRE, Ecole des HEC, Université de Lausanne, 23-24 Septembre 1996.

[Bai97] Baile, S. :"L'EDI: stratégie inter-organisationnelle de la PME," *Gestion 2000*, Vol. 13, N° 4, 1997, pp. 169-183.

[Bai98] Baile, S. : "L'EDI : mythe et réalité de la communication électronique dans les réseaux de PME," in Saint-Amant, G. et Amami, M (Eds) *:Commerce électronique et développement des systèmes de gestion*. Actes du 3ème Colloque International de Management des Réseaux d'Entreprises, UQAM, 31 Août/2 Septembre 1998, pp. 478-494.

[Bai99] Baile, S. : "EDI et PME-PMI: adoption et impact de la technologie sur le développement des réseaux d'entreprises," *Rapport d'Etude*, *Ministère de l'Economie, des Finances et de l'Industrie*, Secrétariat d'Etat aux Petites et Moyennes Entreprises, Au Commerce et à l'Artisanat, Mars (non publié), Mars 1999.

[BT99] Baile, S. ; Trahand, J. (1999), "Les systèmes d'information inter-organisationnels : contributions et cadre des recherches", *Système d'Information & Management*, Vol. 4, N° 2, 1999, p. 3-15.

[Bai01] Baile, S. :"L'alignement du partenariat d'affaire sur le partenariat électronique: étude empirique du succès avec la méthode des équations structurelles", in Baile, S., Zghal, R. et Chabouni, J. (Eds), *Commerce International et Communication Electronique*, Actes du 5ème Colloque International de Management des Réseaux d'Entreprises (CD-ROM), Mahdia-Beach Hôtel, 25-26 Octobre 2001, 32 pages.

[BH01] Baile, S. ; Hassairi, F. : "L'approche systémique pour l'évaluation des investissements en systèmes et technologies de l'information – une application à la technologie EDI", in Amami, M & Limayem, M. (Eds), *Les enjeux du commerce électronique sur internet*, *Revue Tunisienne de Gestion*, n°5/6, Juin-Juillet 2001, pp. 180-206.

[Bai03] Baile, S. : "L'évaluation du succès de l'EDI dans les PME – un modèle intégrateur", in *Annales des Télécommunications*, Tome 58, N° ½, pp. 297-328, Paris, Hermès-ENST, 2003.

[BH03] Baile, S. ; Hassairi, F. : " Impact de l'EDI sur la performance des équipementiers automobiles : l'apport de l'analyse de causalité", *Système d'Information & Management*, Vol. 7, N° 4, 2003.

[BR97] Bergeron, F.; Raymond, L.: "Managing EDI for Corporate Advantage: A Longitudinal Study," *Information & Management*, Vol. 31, N° 6, 1997, pp. 319-333.

[Bo93] Bouchard, L. : "Decision Criteria in the Adoption of EDI," *Proceedings of the 14th International Conference of Information Systems*, Orlando, Fl., 1993, pp. 365-376.

[Bak87] Bakos, Y. : "Inter-Organizational Information Systems : Strategic Implication for Competition and Co-operation", *Doctoral Thesis*, Sloan School of Management, MIT, 1987.

[Bac89]   Bacharach, S.B.: Organizational Theories: Some Criteria for Evaluation, *Academy of Management Review*, Vol. 14, No.4, october 1989, pages 496-515,

[BDS90] Benjamin, R.I.; De Long, D.W.; Scott-Morton, G.: "Electronic Data Interchange : How Much Competitive Advantage", *Long Range Planning*, Vol. 23, N° 1, 1990, p. 29-40.

[BV96]   Bensaou, M.; Venkatraman, N.: "Inter-Organizational Relationships and Information Technology : A Conceptual Synthesis and a Research Framework", *European Journal of Information System*, Vol. 5, N° 2, 1996, pp. 84-91.

[BB80]   Bentler, P.M.; Bonett D.G.: "Significance Tests and Goodness of Fit in the Analysis of Covariance Structures," *Psychological Bulletin*, Vol. 88, 1980, pp. 588-606.[BF83] Bentler, P.M.; Freeman, E.H.: "Tests for Stability in Linear Structural Equation Systems," *Psychometrika*, Vol. 48, 1983, pp. 143-145.

[BC87]   Bentler, P.M.; Chou, C.P.: "Practical Issues in Structural Modelling," *Sociological Methods and Research*, Vol. 16, N° 1,   1987, pp. 78-117.[Ca90] Carlin, A.: Audit Concerns in Electronic Data Interchange. *EDPACS* , Vol. 17, N° 7, pp. 1-7 January 1990 . [CM86]   Chenhall, R.H.; Morris, D.: "The Impact of Structure, Environment, and Interdependence on the Perceived Usefulness of management Accounting Systems", *The Accounting Review*, Vol. 11, N° 1, 1986, pp. 16-35.

[CBD01] Chwelos, P.; Benbasat, I.; Dexter, A.: "Research Report : Empirical Test of an EDI Adoption Model," *Information Systems research*, Vol. 12, N° 3, 2001, pp. 304-321.

[CL90]   Coopers and Lybrand Consultants: Electronic Data Interchange in Australia. *A Coopers & Lybrand Survey of Australia's Top 1000 Companies* (1990) February.

[DT88]   Doll, W.R; Torkzadeh, G.: "The Measurement of End-User Computing Satisfaction", *MIS Quarterly*, Vol. 12, N° 2, 1988, pp. 259-276.

[DMcL03] Delone, W.H.; McLean, E.R.: "The Delone and McLean Model of Information System Success: A Ten Year Update", *Journal of management Information Systems*, Vol. 19, N° 4, 2003, pp. 9-30.

[Em90]   Emmelhainz, M.A : *A Total Management Guide*, NCC Blackwell, 1990.

[EPR93] Evrard, Y. ; Pras, B., Roux, E. : *MARKET : Etudes et recherches en Marketing*, Paris: Nathan, 1993.

[FD96]   Farthoomand, A.F.; Drury, D.H.: "Factors Influencing Electronic Data Interchange Success", *DATA BASE Advances*, Vol. 27, N° 1, 1996, pp. 45-57.

[FP99]   Fearon, C.; Philip, G. : "An Empirical Study of the Use of EDI in Super-Market Chains Using a New Conceptual Framework", *Journal of Information Technology*, Vol. 14, N° 1, 1999, pp. 3-21.

[FA75]   Fishbein, M.; Ajenz, I.; *Belief, Attitude, Intention and Behavior.* Reading Mass. Addison Wesley, 1975.

[HS97]   Hart, P.; Saunders, C.: "Power and Trust: Critical Factors in the Adoption and Use of
          EDI," *Organizational Sciences*, Vol. 8, N° 1, 1997, pp. 23-42.

[HPRS93] Hwang, K.T.; Pegels, C.C.; Rao, R.; Sethi, V. : "Electronic Data Interchange –State of
          the Art", *Journal of Systems Management*, Vol. 44, N° 12, 1993, pp. 12-15.

[IBD95]   Iacouvou, C.L.; Benbasat, I.; Dexter, A.S.: "Electronic Data Interchange and Small
          Organizations: Adoption and Impact of Technology," MIS Quarterly, Vol. 19, N° 4,
          1995, pp. 465-485.

[IR99]   Igalens, J; Roussel, P. : "A Study of the Relation Between Compensation Package, Work
          Motivation and Job Satisfaction," *Journal of Organizational Behavior*, Vol. 20, 1999,
          pp. 1003-1025.

[JS89]   Jöreskog, K.G.; Sörbom, F.: *LISREL 7 : A Guide to the Program and Applications*,
          Chicago, Ill.: SPSS Inc., 1989.

[JP04]   Juménez-Martinez, J.; Polo-Redondo, Y.: "The Influence of EDI Adoption over its
          Perceived Benefits", *Technovation*, Vol. 24, 2004, pp. 73-79.

[KB00]   Kafer, F.; Bendoli, E.: "The Adoption of EDI: A Model and Practical Tool for
          Managers," *Decision Support Systems*, Vol. 15, December 2000.

[KW96]   Kalakota, R.; Whinston, A.B.: *Frontiers of Electronic Commerce*. N.Y., Addison-
          Wesley, Publishing Company,1996.

[KSG04]   Karimi, J.; Somers, T.M.; Gupta, Y.P.: "Impact of Environmental Uncertainty and Task
          Characteristics on User Satisfaction With Data", *Information Systems Research*, Vol. 15,
          N° 2, June 2004, pp. 175-193.

[KS01]   Khazanchi, D.; Sutton, S.G.: "Assurance Services for Business-to-Business Electronic
          Commerce: a Framework and Implications", *Journal of the Associations for Information
          Systems*, Vol. 1, 2001, pp. 1-53.

[LH00]   Lee, S.; Han, I.: "EDI Controls Design Support System Using Relational Database
          System", *Decision Support Systems*, Vol. 29, 2000, pp. 160-193.

[LLK04a] Lee, S.; Lee, K.; Kang, I.: "Efficiency Analysis of Controls in EDI Applications",
          Information & Management, Article in Press, August 2004..

[LKL04b] Lee, S.; Kim, B.G.; Lee, K: "Fuzzy Cognitive Map-Based Approach to Evaluate EDI
          Performance: a Test of Causal Model", *Expert Systems with Applications*, Vol. 27,
          2004pp. 287-299.

[LJ94]   Lim, S.B.; Jamieson, R.: EDI Risks, Security and Control: An Australian Survey, in the
          Fifth Australiasian Conference on Information Systems, 1994.

[Lu74a]   Lucas, H.C.: "Systems Quality, User Reactions and the Use of Information Systems",
          Management *Informatics*, Vol. 3, N° 4, 1974, pp. 207-212.

[Lu74b]   Lucas, H.C.: "User Reactions to Computer Operations", *Sloan Management Review*, Vol. 15, N° 3, 1974, pp. 59-67.

[Lu75a]   Lucas, H.C.: "Performance and the Use of an Information System", *Management Science*, Vol. 20, N° 8, 1975, pp. 908-918.

[Lu75b]   Lucas, H.C.: *Why Information Systems Fail ?* New-York: Columbia University Press, 1975.

[MC93]   Marcella, A.J. Jr.; Chan, S.: , *EDI Security, Control and Audit*, Artech House Inc., 1993.

[Me92]   Menkus, B.: Understanding EDI Security Issues, *Computers & Security*, Vol. 11**,** N° 6, pp. 525–528, October 1992 .

[MKK95] Mukhopadhyay, Y.; Keyre, S.; Kalathur, S.: "Busines Values of Information Technology: A Study of Electronic Data Interchange", *MIS Quarterly*, Vol. 19, N° 2, June 1995, pp. 137-156.

[MKP98] Mukhopadhyay, Y.; Keyre, S.; Pokorney, T.: Strategic and Operational Benefits of Electronic Data Interchange, Working Paper GSIA, Carney Mellon University, 1998.

[MJABS89]Mulaik, S.A.; James, L.R.; Alstine, D.J.; Benett, N.; Lind, S.; Stilwel, C.D.: "Evaluation of Goodness of Fit Indices for Structural Equation Models," *Psychological Bulletin*, Vol. 105, 1989, pp. 430-445

.[Na03]   Nakayama, M.: An Assessment of EDI Use and Other Channel Communications on Trading Behavior and Trading Partner Knowledge*, Information & Management*, Vol. 40, 2003, pp. 563-580.

[Ni02]   Nicolaou, A. L.: "Adoption of Just-In-Time and Electronic Data Interchange Systems and Perceptions of Cost Management Systems Effectiveness," *International Journal of Accounting Information Systems*, Vol. 3, N° 1, 2002, pp. 35-62.

[Nu78]   Nunnally, J.C.: *Psychometric Theory*. New-York: MacGraw-Hill, 1978.

[O'Br04] O'Brien, J. A.: *Management Information Systems – Managing Information Technology in the Business Enterprise*. New-York : MacGraw-Hill Comp., 2004.

[PP-S91] Pedhazur, E.J. et Pedhazur-Schmelkin, L.: *Measurement, Design, and Analysis : An Integrated Approach*, Hillsdale, N.J.: Lawrence Erlbaum, 1991.

[Pi98]   Pillet, J.L. : *Evaluation des pré-requis pour l'échange de données informatisées*. Thèse de Doctorat en Gestion, Université de Genève, Ecole des HEC, Décembre 1998.

[PR95]   Premkumar, G.; Ramamurthy, K.: "The Role of Interorganizational and Organizational Factors on the Decision mode for Adoption of Interorganizational Systems", *Decision Sciences*, Vol. 26, N° 3, 1995, pp. 303–336[RS97] Ratnasingham, P.; Swatman, P.A.: "Security in the EDI Context", in *First Pacific-Asia Workshop in Electronic Commerce (PAWEC)*April 5th, Brisbane, Queensland University of Technology, 1997.

[Ra98]   Ratnasingham, P.: "EDI Security: The Influences of Trust on EDI Risks", *Computers & Security*, Vol. 17, 1998, pp. 313-324.

[Ra99]   Ratnasingham, P. "Implicit Trust in the Risk Assessment Process of EDI", *Computers & Security*, Vol. 18, 1999, pp. 317-321.

[RKM94] Riggins, F.J.; Kriebel, C.H.; Mukhopadhyay, T.: "The Growth of Interorganizational Systems in   the Presence of Network Externalities", *Management Sciences*, Vol. 40, N° 8, August 1994, pp. 984-998.

[RM99]   Riggins, F. J.. Mukhopadhyay, T.: "Overcoming Adoption and Implementation Risks of EDI", *International Journal of Electronic Commerce*, Vol. 3, N° 4, 1999, pp. 103-123.

[RO74]   Roberts, K.H.; O'Reilly, C.A.: "Failures un Upward Communication in Organizations: Three Possible Culprits", *Academy of Management Journal*, Vol. 17, N° 2, 1974, pp. 205-215.

[R079]   Roberts, K.H.; O'Reilly, C.A.:   "Some Correlates of Communication Roles in Organizations", *Academy of Management Journal*, Vol. 22, N° 1, 1979, pp. 42-57.

[SM93]   Scala, S.; McGrath, R. Jr.:   "Advantages and disadvantages of electronic data interchange: An industry perspective", *Information & Management,* Vol. 25, N° 2, 1993, pp. 85–91.

[Sc76]   Schewe, C.D.: "The Management Information System User: an Exploratory Behavior Analysis", *Academy of Management Journal*, Vol. 19, N° 4, December 1976, pp. 577-590.

[SK85]   Stern, L.; Kaufman, P.: Electronic Interchange in Selected Consumer Goods Industries : an Interorganizational Perspectives, in Buzzell, R. (Ed.), *Marketing in an Electronic Age*. Harvard Business School Press, 1985.

[VZ90]   Venkatraman, N.; Zaheer, A.;   "Electronic Integration and Strategic Advantage: A QuasiExperimental Study in the Insurance Industry," *Information Systems Research*, Vol. 1, N° 4, 1990, pp. 351-393.

[WB92]   Walden, I.; Braganza, A.:   EDI: Audit and Control. London: NCC Blackwell, 1992.

APPENDIX

provided on request in the original paper, near serge.baile@univ-tlse1.fr