

# Methodology to Assess Risks in Virtual Organization

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**Abstract-** This paper will detail the methodology used to conduct the risk management in virtual organization research. The research this paper describes is an applied research aiming to find practical solutions to a problem that exists in reality rather than being a research that is concerned with theory only. In the first section there will be an introduction and overview of the complex study and the vital need for an innovation design and systematic approach to deal with the area of risk with. In the second section, the research objectives will be summarised to give directions to the rest of the research. In the third section, the design of the research includes primary and secondary research. The approaches including quantitative, qualitative data and triangulation discussion are taken place in the forth section. Section five will deal with the research methods used for this kind of research, describing how the research has been undertaken using combination and triangulation of qualitative and quantitative methods and providing a summary of Warfield's ISM and Saaty's ANP before the conclusion to end the paper.

**Keywords-** Risk; Virtual Organization; VO; ISM; ANP; Networking; SME

## I. INTRODUCTION

The literature makes it clear that the problem that is being discussed is hypothesized as being within the area of risk. The research this paper describes is an applied research aiming to find practical solutions to a problem that exists in reality rather than being a research concerned with theory only. The opinion of Hakim (1987) is one with which the researcher agrees, namely that the difference between research into theory and research into what she calls 'policy', in reality exists only as a matter of emphasis. According to her, the chief aspects distinguishing policy research from theoretical research are as follows:

*"an emphasis on the substantive or practical importance of research results rather than on merely 'statistically significant' findings, and second, a multi-disciplinary approach which in turn leads to the eclectic and catholic use of any and all research designs which might prove helpful in answering the questions posed"* (Hakim, 1987)

The literature review, as previously stated, is crucial to the research, since it provides the information that allows the researcher to come to a definition of the problem which is being researched into, and it is therefore usually the initial step for any research study and that applies to this study also.

The phrase "research methodology" refers to the methods used to undertake research as well as to the logic that underpins those methods. However, each key concept that is to be assessed though the use of the research methodology must be fully understood and the framework for the formulation of the results must be defined, before the methodology to undertake the research can be devised. This is also an aid in reaching an understanding of the information that needs to be collected in order to address the problem or

for meeting the research objectives. The main issues with which this research is concerned are the sources of risk that are intrinsic to Virtual Organisation (VO) collaborations, how they relate to each other and how important they are.

The area to be researched for this study is complex and challenging and therefore the design of it needs to be innovative in order to meet the challenges. A systematic approach was taken, using the research methodology which will be fully explained in this paper.

## II. RESEARCH AIM

The aim of this research is to give support to evaluate collaboration as well as the risks that exist for network enterprise collaboration, to provide the means to carry out assessment of risks across the network, and to analyse the results of those calculations that impact on either the network or the partners in enterprises doing that by identifying those risks that are intrinsic to collaboration between SMEs, to identify any relationships between the sources of those risks and to identify what potential impact they have. A further contribution is made by using tools (ISM and ANP) to enable SMEs to understand the inter-relationships of risk sources and in that way, to provide a means to manage such risks.

In order to undertake this research, it has been necessary to use both quantitative and qualitative methods for the study of the research objectives. For this reason there is a focus on the collection and analysis of both quantitative and qualitative data. In order that a balanced check could be developed, this research was divided into four phases:

1. identification of risk sources in virtual organization collaboration through the use of the literature review and a questionnaire to collect the opinions of experts;
2. a questionnaire survey to collect information for Interpretive Structural Modeling (ISM);
3. a questionnaire survey to collect information for Analytical Network Process (ANP);
4. data collected from interview that was based on case study.

## III. RESEARCH DESIGN

According to Kothari (2005), research methodology provides a means of systematically solving the research problem as well as providing an underlying structure for the research process by means of taking logical steps through the appropriate stages. This research methodology has been planned in such a way that it will achieve the research objectives through the use of the effective collection of data and its analysis together with validation of the same. This procedure will make possible the continuous collection of the knowledge that is necessary for the research process.

Where the purpose of any research is clear, it is possible to

put in place a suitable research design, although it should be noted that research design is not the same as data collection. The design of the research is able to impose a logical structure on it, while the data for the research can be collected by any available method for data collection, since how this happens is of no relevance to the design (De Vaus, 2001). According to Yin's (1994) research design, "*deals with a logical problem and not a logistical problem*" means that it is different from a work plan which will state what needs to be done but which has only been arrived at as a consequence of the research design. In a definition of research design DeVaus (2001) states that "*the function of a research design is to ensure that the evidence obtained enables us to answer the initial question as unambiguously as possible*".

For meaningful research, relevant evidence must be amassed in order to address the research question(s), to test theory (ies) and to prove the hypothesis in a way that will withstand scrutiny. For this to happen, decisions must be taken in relation to what types of data must be collected and analysed and what methods should be used. Both the number and type of the methods that are to be used will usually be described in the research design (Sarantakos, 1998). Yin (1994) suggests that the starting point for the researcher should be a theoretical proposition since this makes it easier to devise the research design, decide the data that should be collected, and what technique(s) should be used for analysis. Where the usage has been made of a wider literature base so that ideas that are not normally linked are brought together, such as VO, ISM and ANP, it provides "*a theory with stronger internal validity, wider generalisability, and higher conceptual level*" (Eisenhardt, 1989).

In the case of this research, as well as drawing on wide-ranging literature, a number of methods for the collection of data were also used. It is vital that the research strategy should be well-chosen in order to gather the information for the sources of risk in VOs which are being investigated here.

#### A. Primary Research

Primary research is the collection of fresh, previously non-existent data which the researcher will have to undertake for himself. The collection of primary data has important advantages compared with other methods (Brace, 2004; Saunders et al., 2009). Primary research can gather first-hand information and therefore information that has never been used before becoming available. In general, there are two methods for the collection of primary data and these are the use of questionnaires and of interviews (Saunders et al., 2009). The first phase of this research makes use of a questionnaire, which is a structured sequence of questions which have been devised to elicit facts and opinions thereby establishing a base for the recording of data (Hague, 2002). A number of factors must be taken into account when designing a questionnaire (Oppenheim, 1992):

1. the type of research;
2. the sample size;
3. the characteristics of the sample.

To gather the required information from the respondents, two types of question can be used: open questions and closed questions. For this research, use closed questions was used in the questionnaire and open questions in the case study, based on findings from secondary research. In this way the use of relevant and appropriate questions was ensured.

#### B. Secondary Research

Secondary research is the examination of data that has previously been collected by another person and it is used when a summary or collection of existing data is necessary for the research. Such secondary sources might include reports from previous research, the content of journals, conferences and books as well as other sources. On occasion it is necessary to undertake secondary research in the preliminary stages of a research in order to make clear what is known already and consequently what new data might be necessary, or else as a basis for the research design.

Secondary research should precede primary research since if the secondary research is not carried out, primary research which could involve considerable expense might be commissioned only to give information that might have been gathered from previously existing sources (Mort, 2003; Hague, 2002). For this reason, secondary research must be undertaken before any primary research is embarked upon. Advantages provided by secondary data are the saving of time and money and the fact that it can yield data for both comparison and context (Saunders et al., 2009). It is also the case that where secondary data is analysed again, it can lead to the uncovering of unexpected new facets.

The disadvantage attaching to it is that it may have been collected for a different research purpose, which will not be the case with primary data and therefore it may not be applicable to the research question in hand, or it may, quite simply, be out of date.

### IV. RESEARCH APPROACHES

The phrase "research approach" includes the terminology, tools, and instrument and all other means that are used to examine the various factors that come into use once the design of the research has been decided upon. Within the social science, there are two fundamental approaches, which being the quantitative approach and the qualitative approach, the difference between the two having been an issue for academic debates between researchers over recent decades (Bryman, 1988).

Within the literature, disagreements exist as to the value and use of quantitative methods as compared to qualitative methods. From this fact, it may be inferred that whether quantitative and/or qualitative data are likely to be of greater use is dependent on what precisely is being researched and from what perspective. In almost all areas of social research, and this includes areas such as education, business management and others, research designs have been formulated mainly, if not exclusively, on qualitative rather than quantitative data and this is now accepted as being acceptable and, indeed, respectable (Robson, 2002). Nevertheless, it is still accepted that research designs will choose to use either one or the other so that social surveys, for example, are more likely to be regarded as being quantitative research, making use of statistics in a quantitative method and for the resulting analysis, whereas case studies will be seen as being undertaken using qualitative research, using interpretation in the analysis of data and examining elements of the study in their context and taking into account people's subjective meanings (De Vaus, 2001).

According to Bellenger and Greenberg (1978) the qualities of good research are as follows (Kothari, 2005).

1. Good research is conducted systematically, which means

that the necessary steps are specified and are then followed in a specific sequence and adhering to a defined set of rules. However, because the research is conducted systematically, this does not mean that creative thinking is excluded. What is excluded, though, is the use of guesswork and intuition to arrive at a conclusion.

2. Good research uses logic which means that it is conducted using the valuable methods of logical reasoning as well as logical processes of induction. A definition of induction is the use of reason to progress from a part to the whole, while deduction means that a conclusion is reached that follows directly from a specific premise. Where research is to be used for the purpose of making decisions it is of greater value where conclusions have been arrived at as a result of logical reasoning.
3. Good research is based on experiment and observation which means that it essentially relates to a real situation in one or more ways and deals with empirical data so that the research results can be externally validated.
4. Good research can be reproduced which means that its results can be verified by an exact repetition of the study, which gives a solid base for making decisions.

#### A. Quantitative Data

Bryman (2001) defined quantitative research as a distinctive research strategy that makes use of the “... collection of numerical data and exhibiting a view of the relationship between theory and research as deductive, a predilection for a natural science approach, and as having an objectivist conception of social reality”.

For quantitative research in this area, the foremost method for the collection of data is the social survey which is able to generate quantifiable data relating to a large number of people who are selected in order to test hypotheses, and this is why it has been so widely used. The approach to a social survey is different from the principles of quantitative research as it is used in the sciences (Bryman, 1988).

In scientific experiments and descriptive surveys, as in any kind of research where categorization is possible, what is being studied can be categorized in such a way that counting can be used, quantitative data are the primary data that are collected and the usual method for its collection is through standardized instruments for observation, such as questionnaires, carefully constructed interviews and other methods. The collection and analysis of quantitative data make it possible to deconstruct complex issues and assign to them numerical values (Kerlinger, 1986). Since it exists in a numerical form, it is possible to easily analyze a great deal of quantitative data using computerized statistical analysis tools and programs, and therefore surveys can be undertaken using large population samples.

#### B. Qualitative Data

In contrast to quantitative data, qualitative data are “a source of well-grounded, rich descriptions and explanations of processes in identifiable local contexts” (Miles and Huberman, 1994).

Qualitative research has also been defined by Preissle (2002) “... as a loosely defined category of research design or models, all of which elicit verbal, visual, tactile, olfactory, and gustatory data in form of descriptive narrative like field notes, recordings, or other transcriptions from audio and videotapes

and other written records and pictures or films”.

The main sources for the collection of qualitative data are in depth, open-ended interviews, direct observation, and written documents. The data from interviews will, in the main, be made up of direct quotation where people talk about their experiences and feelings and give their opinion as well as divulging their knowledge, in response to open-ended questions (Patton, 1990). From the use of open-ended questions, the researcher is able to discover and understand people’s points of view, without having been predetermined through prior selection as is likely to be the case where they form part of a questionnaire category. Other sources of information are administrative and archival records (Yin, 1994). Concepts are developed through the use of qualitative data rather than concepts that are already established being applied, in order that phenomena can be understood and therefore explained; thus, qualitative research is, in essence, an investigative procedure.

Whereas samples collected for quantitative data tend to be random, those collected for qualitative data tend to be more purposive. This arises partly because the initial universal definition is more limited but also because there is a logic and consistency in social processes that could not be addressed by random sampling (Miles and Huberman, 1994).

According to Strauss and Corbin (1990), there are three major components of qualitative research.

- Firstly, typical sources for data are interviews and observations and for this research an interview has been conducted with a representative of the case study.
- Secondly, analytic or interpretive procedures are used to conceptualize data; in this case, categorization is used. For this research the answers and information provided have been categorized according to the themes in the research.
- Thirdly, written and oral reports are used.

The need for a deep understanding of some elements of the research has dictated that a qualitative approach should be used for this research. This deep understanding has been necessary in order to create a new architectural solution as well as a new theory for this subject.

The aim of qualitative research is to focus on problems in the real world with all the complexity that this implies. Qualitative researches do not often attempt to simplify the problematic situation that is being studied, rather they aim for a recognition of the fact that the problem being studied is multi-layered and has many dimensions and therefore they attempt to consider it from all angles and aspects (Leedy and Ormrod, 2010).

#### C. Triangulation

It is usual for a research to make use of only one basic methodology and take from only one methodological context, which is the qualitative or the quantitative (Sarantakos, 1998). For a number of years many authors have vigorously opined that qualitative methods should be used rather than the quantitative methods that have generally been dominant, although this view has, in turn, been forcefully argued against by those who support quantitative methods. The argument has also been made that this division between the two methods has created a line of demarcation that is artificial and has led to unnecessary conflict between scientists (Gummesson, 1991). Consequently, a third group has been formed of those who argue for a combination of quantitative and qualitative

methods. Where these different methods for the collection of data are combined for use in such areas as surveys and experiments, or observation and methods using documents, in order to examine the same social issue, it is called triangulation and is used by both quantitative and qualitative researchers (Sarantakos 1998). It is held that triangulation is able to improve the rigour of research and enable the researcher:

1. to gather a range of information dealing with the same issue (Sarantakos, 1998; Robson, 2002);
2. the strengths in each method are able to compensate for the shortcomings in the other;
3. a greater degree of validity and reliability can be achieved;
4. the shortcomings of single method studies are eliminated;
5. ease of interpreting the study is improved.

## V. SELECTION OF RESEARCH METHOD

This study makes use of two popular methods to fulfill its objectives, these two methods being the use of a questionnaire and a case study. The various types of research methods that are available were reviewed and the conclusion was reached that in order to achieve the objectives of the research the most appropriate method to employ was the combination of a quantitative method, through the use of a questionnaire, with a qualitative method, using a case study, so that methodological pluralism would be achieved (Ragsdell and Wilby, 2001), which can provide fuller data and therefore a stronger base for the research finding analysis. By using these two methods together, an extremely effective mechanism is provided for the combination of both quantitative and qualitative research approaches. According to Krueger and Casey (1994),

*“increasingly researchers are recognising the benefits of combining quantitative and qualitative procedures, resulting in greater methodological mixes that strengthen the research design”.*

Churchill (1995) states, *“The problem as finally defined will often suggest one approach over the others, but the researcher should recognise that the approaches often can be used most productively in combination”.* Nonetheless, there is no best method for the collection of data and which method is chosen will depend on the nature of the research questions that are being asked and the particular questions that the researcher wants to put to the respondents. What all methods aim to achieve are valid and reliable answers in response to the questions asked, which have not been distorted by the methods used for collection and which are not subject to chance fluctuations (Wilson, 1996).

### A. Questionnaires

The questionnaire survey was conducted in order to collect quantitative data and analyse them. A questionnaire is a list of questions that the researcher asks which is devised in such a way that each respondent is asked exactly the same questions. It may be administered in a number of ways: it can be completed by the respondent while the researcher waits, or else sent through the post to the respondent and then back to the researcher, or it may be completed online and sent by email; in the latter two cases it is likely to be completed without any supervision (Chapman and McNeill, 2005; Dane, 1990; Schonlau et al., 2002).

This questionnaire was administered by email and the advantages and disadvantages of using an electronic questionnaire are summarised in Table (I-1) (Sekaran, 2003).

TABLE I-1 ADVANTAGES AND DISADVANTAGES OF ELECTRONIC QUESTIONNAIRE (SEKARAN, 2003)

Advantages of the Electronic Questionnaire	Disadvantages of Electronic Questionnaires
Easy to administer	Computer literacy is a must
Can reach globally	Respondent must have access to the facility
Very inexpensive	Respondent must be willing to complete the questionnaire
Fast delivery	
Respondent can answer at their convenience like the mail questionnaire	

A questionnaire that is sent through the post or using an email can be sent over a much wider geographical area than one that is administered personally. Cost can be minimized, both in terms of data collecting and of processing, and it is free from having bias exerted by presence of the researcher. Since in this instance the experts that were to be questioned are located over a wide geographical area, the use of the internet to send the questionnaire was adopted.

Three questionnaires based on questions were designed to obtain the respondents' views on the relationships and the

weights of these risk sources. The respondents to the questionnaire must be able to understand the questions in the way that the researcher intends, have access to the information needed to answer them, be willing to answer them, and actually answer them in the form called for by the question. It may therefore be necessary to alter the language of the question so that respondents find it understandable and unambiguous (Robson, 2002).

Questionnaires have both advantages and disadvantages. Table (I-2) illustrates the main advantages and limitations.

TABLE I-2 ADVANTAGES AND LIMITATIONS OF QUESTIONNAIRES (ROBSON, 2002)

Advantages	Limitations
Less expensive than other methods	Do not allow probing or clarification
Produce fast results	Motivate respondents to participate
Can be completed at the respondent's convenience	Researcher does not know whether the intended person answered the questions
Anonymity	Impossible to check question order followed
Less opportunity for bias	No opportunity to collect further information via observation
Stable, consistent, uniform measure	No supervision therefore partial response possible
Objectivity	Questionnaire requires simple questions to be asked
Wide Coverage	Not as good for providing new insights and ideas as interviews
It does not require a trained interviewer	Low response rate to questionnaires

The final disadvantage that a questionnaire has can also be seen as the most serious one that there is often a low response rate so that it is not possible to obtain an adequate rate of response. For this study, this problem was overcome by sending the questionnaires to respondents who were experts in this particular field and therefore would be likely to be interested in this study.

In addition other important limitations of a questionnaire survey where it may be difficult to obtain in-depth or detailed responses were surmounted by supplementing it with a case study for the final phase of this research. The combination of these two methods has added to the strength to this study in a way, which would not have been possible by using one method only.

The second and third questionnaires were used for ISM and ANP and the following is a summary of these tools.

### 1. Interpretive Structural Modeling (ISM)

The literature and expert opinion both from the academic world and from industry were used to identify the sources of risk to SME collaborations. An analysis was made of the relationships between these sources of risk and the dependences and the driving power for each source in relation to the other sources in order to provide a risk management contribution for those SMEs either planning to join a VO or already in one.

It demonstrated what the risk sources are threatening collaboration and also which sources would be likely to increase the risk from other sources. For this analysis, it was necessary to examine the direct and indirect relationships between the sources rather than examining each one in isolation.

ISM technique has been applied to analyze the relations between these risks sources and to understand the dependence and the driving power of each risk's sources in relation to the other sources. ISM is a tool to facilitate management decisions through linking ideas in order to enable the understanding of complex situations. ISM is able to set up, examine and tackle general issues and problems. Warfield (1987) states that "*it is a general system methodology in that its application is not confined to any discipline, but rather can be used to explore general issues and problems*".

ISM is one of the tools of interactive management (Warfield, 1974). It provides an established methodology to identify and summarise the relationships between particular aspects. It is able to define an issue or a problem and it provides a mean to impose order on the complexity stemming from these various elements (Mandal and Deshmukh, 1994). The developed model is described in words as well as being shown graphically.

### 2. Analytical Network Process (ANP)

This research uses an ANP approach. The use of ANP is not restricted to a particular size of business but has been widely used in support of decision-making in SMEs. As well as having a sound record in industry, the method of ANP is more appropriate in relation to the nature of the proposed models than other techniques. For example, the proposed supplier selection method involves tangible and intangible criteria, which require measurements that have the following functionalities: to provide a realistic description of the problem, to structure the decision-making process, to

incorporate both quantitative and qualitative factors, to express the relative importance of factors, to analyse alternatives, to support group decision-making and to allow the decision makers to focus on each small aspect of the problem. The ANP approach satisfies all these requirements described above. The ANP approach was developed by Saaty, which is a decision-making method for prioritizing (Saaty, 1982; 2004).

### B. Case Study

A case study is an in-depth study of a single example of whatever it is that the researcher wants to investigate. According to Ormrod and Leedy (2010), a case study consists of an in-depth study over a defined period of time of a particular individual, program or event. Depending upon the situation, the researcher is able to focus on either a single case or else two or more cases. They also make the point that a case study is of particular use to understand more about a situation about which little known is or which inadequately understood is. It also provides a useful way of either providing initial support or generating support for hypotheses.

A case study was decided upon as one of the methods for this research and in this case study use was made of the structured interview which consists of a standardised set of questions. A case study is not a survey, the reliability of which is crucially reliant on the instruments for the collection of data. In a case study it is the trustworthiness of a human instrument that is relied upon, which is the researcher, rather than techniques for the collection of data.

A case study is "*an empirical inquiry that investigates a contemporary phenomenon within its real life context, when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used*" (Yin, 2003).

A case study is an empirical method of analysis resulting in a research report and it allows the use of a combination of methods as well as being flexible. It is considered to be a useful method of case research where the matter under investigation is both broadly based and complex (Dube and Pare, 2003). It is made use of a number of disciplines, such as psychology, sociology or political science, but increasingly it is used to deal with problems in such areas as business and organisation. This is because in business, social phenomena are relevant and must also be studied (Yin, 2003). Lee (1989) defines an organisational case study as "*an intensive study of a single case where the case consists of individuals, groups, and social structure in the setting of an organisation*". It is generally held that the case study approach is useful to investigate the social phenomena involved in the network related risks to VO collaboration.

Case studies are considered to be an adequate method for the evaluation of the effectiveness of any action in a situation where quantitative studies are unable to provide enough insight or explanation for coherences (Haas and Noster, 2007). For this reason, case studies are used for a small number of cases, the reason for undertaking a case study being not to provide results that are statistically representative, but to provide deep insights and understanding in relation to a specific context that is often a social one. Although there are a significant number of cases where the findings could be more robust (Rowley, 2002), there are a small number of cases where the use of case study as a method enables the researcher to uncover material that is richer and more intimate (Halinen

and Toernroos, 2005) and this is the reason why a single case study has been made use of for this research.

The evaluation of case studies must be considered when they are used as a research method for empirical work, though in the case of this research more quantitative methods, for example a questionnaire, have been used to prepare the ground for the case study. A number of approaches that can be employed when undertaking case study research have been evaluated and the use of this approach in this particular research is both explained and justified. The research design itself is then examined and the aims of the research explained, setting out the stages in the process and identifying some of the issues that were met with.

Although a case study appears simple, which is deceptive, the researcher needs to be familiar with existing theoretical knowledge relating to the field of inquiry and must also have the skill to be able to differentiate significant variables from insignificant ones (Duggal et al., 2001). An unbiased approach is an absolute necessity.

TABLE I-3 STRENGTHS AND WEAKNESS OF CASE STUDY (EISENHARDT, 1989)

The Strengths of Case Study	The Weaknesses of the Case Study
Enhancement of theory building	Overly complex (though arguably rich) picture
Empirical validity strengthened as it arises from the data itself	It is difficult to generate simple models
Emergent constructs are more likely to be measurable	The narrow, idiosyncratic outcomes may not yield much in terms of generalisable outcomes or theory
	There is the danger of building around the preconceptions of the researcher and modification of data to fit this view

Although accepting the potential weaknesses of the case study model, its strengths were compatible with being used to examine the research question. The research is appropriate for case study methodologies because “the focus is on a contemporary phenomenon within some real-life context” (Yin, 1994). Making a similar point Mitchell (1983) states that by choosing to undertake a case study, the researcher has acknowledged the potential that the case study has to illustrate a particular theoretical principle. Also the use of a qualitative case study methodology has been supported by the empirical work that has been done and Yin (1994) suggests the use of a case study in circumstances where the researcher specifically needs to deal with context.

Eisenhardt (1989), when examining the approach taken in a number of research studies that have used this method, concludes that the combination of methods that are used, including historical records, internal documents, quantitative analysis, interviews and observations, constitutes the strength of this approach with the validity of the findings being underpinned by corroboration and triangulation. Today, rather than being seen as an preparatory undertaking to quantitative studies that have limited value in their own right, case studies are considered to be a valid form of enquiry (Sarantakos, 1998; Robson, 2002). Their validity is particularly justified in a situation where the context of the research is too complicated for survey studies or experimental approaches, but where the researcher wishes to investigate the structure, processes and outcomes of a single unit (Sarantakos, 1998).

In real life situations, it is not always possible to separate phenomenon and context, but the case study employs a set of technical characteristics, including data collection and data analysis strategies, which can be seen as its defining features.

The purpose of a case study is “to tell a big story through the lens of a small case” (Tan, 2004). Case studies are undertaken to focus on what is typical and this then leads on to meaningful generalization and scientific abstraction which would be prevented by uniqueness (Majumdar and Gupta, 2001). The case study method is suitable for those situations where the phenomena as well as the context in which they occur are difficult to prize apart.

The selection of a case study was made in order to identify the strength of relationships in the ISM model and to find the probability of the occurrence of the sources of risks. In addition, it validated the contribution for the research which had been identified through the previous questionnaires. Eisenhardt (1989) maintained that the case studies “is a research study which focuses on understanding the dynamics present within single settings”, and it has a long and influential history in the field of business research.

Table (I-3) shows the strengths and the weaknesses of case studies as summarized by Eisenhardt.

The case study inquiry as defined by Yin (1994):

- is able to cope with the technically distinctive situation which will have a number of variables proving of more interest than data points are able to, giving one result;
- relies on many sources for evidence with data needing to come together as in triangulation, giving another result;
- the preparatory development of theoretical propositions to guide data collection and analysis which is beneficial to a case study.

To summarize, the important points of case study research are that (Robson, 2002):

1. a strategy, i.e. a stance or approach, rather than a method, such as observation or interview;
2. concerned with research, in a broad sense and including, for example, evaluation;
3. empirical in that it relies on the collection of evidence in relation to what is happening;
4. about the particular: a study of that specific case;
5. focused on a phenomenon in context, typically in situations where the boundary between the phenomenon and its context is not clear;
6. undertaken using multiple methods of evidence or data collection.

The points listed above support the view that case study is very appropriate for research into the risks in VOs.

### C. Control 2k as a Case Study

Along with their numerous advantages, virtual organizations (VOs) together with the virtual integration of

supply chains also pose several challenges, including risks such as lack of trust, lack of top management commitment, insufficient information sharing, inadequate collaboration agreements, ontology differences, risk from heterogeneity, structure and design risks, loss of communication, culture differences, difficulties arising from geographic distribution, knowledge about risks, bidding for several VOs at the same time and wrong partner's selection (Alawamleh and Popplewell, 2010). They all require serious attention in the formation and the operation of the VO.

We used a case study method (Yin, 1994) in our study to be able to explore the studied phenomena in more depth. The case study method is especially suited in situations where the purpose is to gain a deeper understanding of the research subject. Our data were gathered mainly through in-depth on site structured interviews with two managers representing their enterprises, which access to some limited documentation and visit to the different departments of the enterprise. Review of the literature early took place before this case study.

The purpose of this study is to provide an understanding of risk sources in the context of VO. In addition, we seek to assess risk sources and relate them to the level of VO collaboration. Although this study focuses on small and medium enterprises (SMEs), it is expected to provide a holistic understanding of risks and their implications for the whole of VO, with wider applicability.

The single case study proved to be an effective methodological approach for conducting this research and as a

consequence provided a rich insight into the phenomena of risks in VO. The case was exploratory as there have been no previous studies of risks conducted in a VO which has focused on a single enterprise, which was required here because of the sensitivity of the research subject. The researcher embraced a somewhat 'native' approach, blending into the enterprise 'as one of them' rather than being seen as an investigator. This was an advantage, as respondents were less reluctant to share information, and as trust between the researcher and respondents developed so did the access to sensitive information increase.

This collaboration risk management case study has been undertaken with Control 2K Ltd as they have a great deal of collaboration experience. To protect enterprise interests, confidential or sensitive enterprise information has been filtered. In addition, information related to sensitive collaboration risks has been omitted.

This ISM model developed (Figure 1) provides the opportunity to understand the risk source relationships at a network level in the collaborative networks. It is clear that awareness about risks sources is very important as it can lead to the undertaking of efforts to mitigate and minimise these risks. A more complete understanding of these risks sources and their relationships, through logical structure, will help partners to make better decisions on whether to join the network or not and even to assess the risk in the collaboration process. Risk sources in collaborative networks have become more integrated and dependent on partners' relationships.

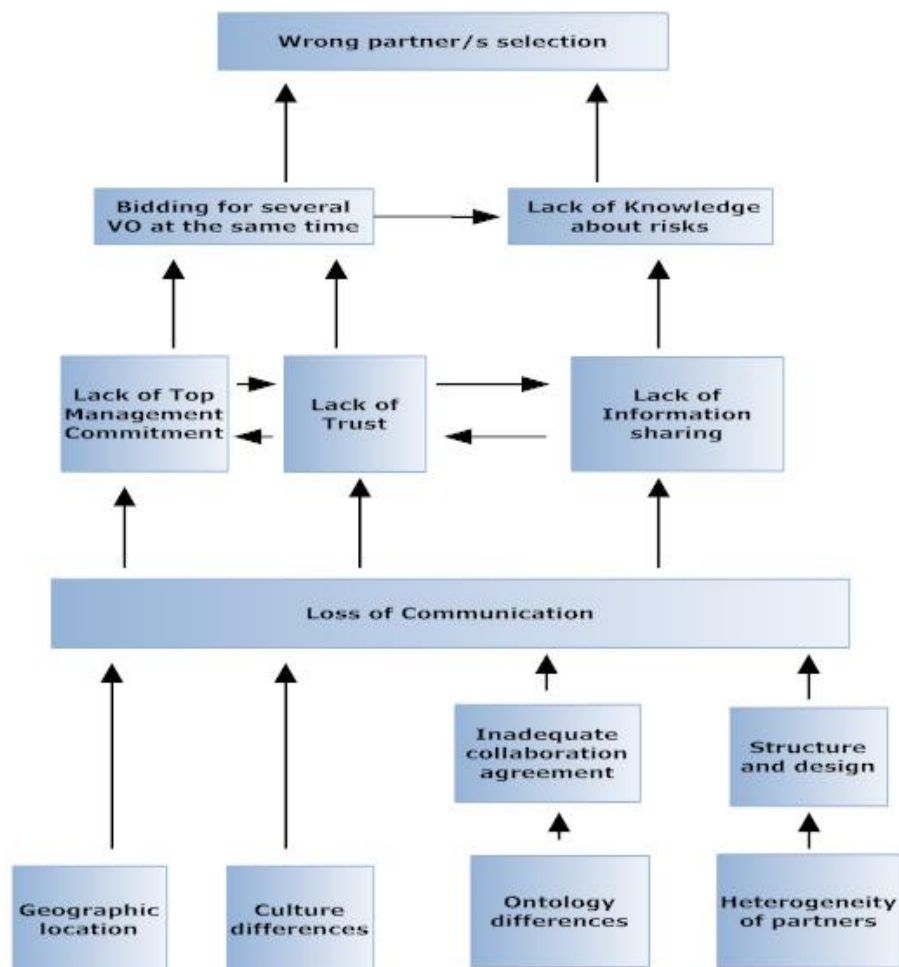


Fig. 1 ISM model (Alawamleh and Popplewell, 2011)



Several relationships between sources have been identified (Table II) with much discussion on some of these relationships, less on others. This gave an indicator of the relative importance of these sources and their relations.

TABLE II RISK SOURCES RELATIONSHIPS SUMMARY

<b>Loss of Communication</b>	
<b>Research Findings</b>	<ul style="list-style-type: none"> <li>The experience gained from Control 2K case study has supplied the evidence that where enterprises make it easier for there to be frequent interaction and communication using video conferencing and emails, this leads to enhanced cooperation.</li> <li>Poor communication has been significantly detrimental to trust and therefore damaging to relationships, with partners not feeling able to place reliance on work, demonstrating that any unreliable partner impedes progress.</li> <li>Control 2k also made it clear that communication is crucial to collaboration and without it there is, in effect, no relationship.</li> <li>Ontology is concerned with the structure of relationships and with the relationships existing between subsets and therefore the use of different ontologies will have an impact on the collaboration agreement. Where the collaboration agreement itself is poor communication will suffer, with inaccurate communication having potentially more adverse effects than no communication at all.</li> <li>Communication between partners is made easier where the structure and design of the VO is clear since the partners will be aware of the common framework.</li> <li>Information sharing is made possible by effective communication and it is also possible to establish good trust.</li> <li>Communication is so critical where it is the only link between the independent and dependent risk sources, between geographic locations, between cultures and ontology differences, between inadequate collaboration agreement and structure and design, and in circumstances where differences between partners have led to problems with design and structure.</li> <li>Loss of communication may result in adverse impacts on other apparently dependent risk sources, such as lack of top management commitment, of trust and information sharing, as well as bidding simultaneously for several VOs, and having lack of knowledge about the risks involved and engaging in a poor selection of partners.</li> </ul>
<b>Lack of Trust between Partners</b>	
<b>Research Findings</b>	<ul style="list-style-type: none"> <li>A VO may contain several cultures and this may lead to incompatibility problems with regard to process, poor communication and its impact on the trust and sharing of information.</li> <li>Trust cannot be built without communication since trust is founded on communication.</li> <li>There are eight sources that have an impact on trust: geographic location, culture, ontology, heterogeneity, collaboration agreement, structure and design, information sharing and top management commitment.</li> <li>Trust itself can increase the commitment from top management as well as increasing information sharing and knowledge of risks but, when trust is lost, this can result in bidding for more than one VO at the same time and to the selection of unsatisfactory partners.</li> </ul>
<b>Lack of Top Management Commitment</b>	
<b>Research Findings</b>	<ul style="list-style-type: none"> <li>Commitment does not come with trust guaranteed but where there is no commitment a lack of trust will follow.</li> <li>New business sought more than VO bid at the same time which does not necessarily indicate a lack of commitment since there are occasions when it is necessary for SMEs to look for new business. It is the case that, generally, more than one VO has to be bid for in order to gain a single opportunity. Risk occurs when any enterprise undertakes to do more work than its capabilities can sustain.</li> <li>It is possible to see that lack of commitment by top management is an important risk source with many relationships dependent on the seven sources of geographic location, culture differences, ontology differences, heterogeneity of partners, lack of structure and design, inadequate collaboration agreement and loss of communication.</li> </ul>
<b>Information Sharing</b>	
<b>Research Findings</b>	<ul style="list-style-type: none"> <li>Lack of information sharing as the ISM shows are dependent on geographic location, culture differences, ontology differences, heterogeneity of partners, lack of structure and design, inadequate collaboration agreement and loss of communication.</li> <li>Lack of information sharing having bidirectional relation on both lack of trust and lack of top management commitment.</li> <li>The lack of information sharing leads to an increased knowledge of threats source that could damage a VO whereas poor information sharing can lead to the selection of the wrong partner/s.</li> </ul>

## VI. CONCLUSION

The following is a summary for the methodology-data collection:

- literature review to support problem definition;
- quantitative and qualitative methods have been used for this study so a balanced check could be developed using four phases:
  - identification of risk sources in virtual organisation collaboration through the use of the literature review and a questionnaire to collect the opinions of experts;
  - a questionnaire survey to collect information for ISM;
  - a questionnaire survey to collect information for ANP;
  - data collected from interview that was based on case study.

This paper has provided an overview of research methods used in the risk management in VO study. A range of methods

was considered to be the most suitable approach to the collection and analysis of the data relevant to this research. An analysis of the underlying debates was undertaken in order to justify the methods that were selected. In order to utilize the positive aspects of both qualitative and quantitative research approaches, methods were selected that included the use of a questionnaire and a case study, and the use of Warfield's ISM and Saaty's ANP.

It should be realized that for any research the choice of a methodology that is best suited to the aims of the research is of critical importance. However, at the same time, concerns relating to the methodological 'purity' of the research should not be allowed to overshadow its aims. After describing the principles of the research and emphasizing the importance of logical design appropriate for the explicit purpose of the research, this paper has proceeded to give an explanation of the provenance of the research question that the research addresses. The methodology that has been used for this thesis includes an extensive literature review that has been dealt with in an earlier paper and also employs the use of a set



questionnaire and a case study. A variety of tools have been used, employing both quantitative and qualitative data collection and analysis.

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