

5-15-2012

# MAKING SENSE OF INFORMATION SYSTEM USE THROUGH THE TRIADIC RESEARCH METHOD

Igor Crévits  
*Univ Lille Nord de France*

Michel Labour  
*Univ Lille Nord de France*

Follow this and additional works at: <http://aisel.aisnet.org/ecis2012>

---

## Recommended Citation

Crévits, Igor and Labour, Michel, "MAKING SENSE OF INFORMATION SYSTEM USE THROUGH THE TRIADIC RESEARCH METHOD" (2012). *ECIS 2012 Proceedings*. 79.  
<http://aisel.aisnet.org/ecis2012/79>

This material is brought to you by the European Conference on Information Systems (ECIS) at AIS Electronic Library (AISeL). It has been accepted for inclusion in ECIS 2012 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact [elibrary@aisnet.org](mailto:elibrary@aisnet.org).

# MAKING SENSE OF INFORMATION SYSTEM USE THROUGH THE TRIADIC RESEARCH METHOD

Crévits, Igor, Univ Lille Nord de France, F-59000 Lille, France ; UVHC, LAMIH, F-59313 Valenciennes, France, [igor.crevits@univ-valenciennes.fr](mailto:igor.crevits@univ-valenciennes.fr)

Labour, Michel, Univ Lille Nord de France, F-59000 Lille, France ; UVHC, DeVisu, F-59313, Valenciennes, France, [michel.labour@univ-valenciennes.fr](mailto:michel.labour@univ-valenciennes.fr)

## Abstract

*The paper presents a novel research methodology, called the Triadic Method to highlight users' personal sense making process. The methodology is drawn from the work of Norbert Elias (1991), George Kelly (1963) and Max Weber (1897). To illustrate the relevance of the Triadic Method, the paper presents a case study of how an experienced user, here an air traffic controller, goes about using an Information System (IS) when resolving a problem in an urgent situation. In adopting a broad Resource Dependency Theory (RDT) approach, the results of the study show how air controllers' decision making process nuances a strict interpretation of Herbert Simon's (1977) hypothesis of "limited rationality". An analysis of the data reveals that air traffic controllers' use IS related data to disconfirm a series of possible choices in a systematic elimination process when resolving an air traffic conflict. These findings have methodological implications for future development of ISs, notably in a current multidisciplinary research project called SAMOSA, concerning the implementation of whole-body, millimetre wave imaging scanners of passengers in French airports.*

*Keywords: Triadic Method, Decision making, Value system, Resource Dependency Theory*

One of the issues of Information Systems (IS) is understanding how end users make sense of grounded data in their everyday activities. Specialists like Díez and McIntosh (2009) point out that there is a major debate in IS literature about the nature of how users continue using an IS at grassroots level. The debate is fuelled by the idea that a better knowledge of continued use of an IS leads to increased “effectiveness/efficiency, decision making quality and inter-organisational collaboration” (Díez & McIntosh, 2009, p. 591). It is in this context that our paper presents a research methodology explaining how users in this case, air traffic controllers, make sense of a continual flow of IS generated data when solving air traffic conflicts. The thrust of this presentation is focussed on the Triadic Method as a way to better understand a user perspective of IS related data.

In the section that follows a literature review of IS use and implementation is presented as a backdrop to our research framework. This is followed by an outline of the micro-social research framework of the Triadic Method. Then follows an explanation of the research method in its programmatic aspects. The final section of the paper describes the findings of the research.

## 1 Literature review

Díez & McIntosh’s (2009) review of IS implementation theories cite a number of significant studies into the challenges of getting a grip of IS use from an organisational point of view. They classify these different theories into three broad groups (Díez & McIntosh 2009, p. 590-592).

The first group is described as Innovation Diffusion Theory (IDT) into how different sections of the population adopt innovations over time. For Rogers (1995) a population of adopters can be divided into five categories: *Innovators* (venturesome, educated, multi information sources), *Early adopters* (social leaders, educated), *Early majority* (deliberate, many informal social contacts), *Late majority* (sceptical, lower socio-economic status) and *Laggards* (fear of debt, neighbours and friends are main information sources). According to Rogers (1995, p. 162) a technological innovation tends to go through five basic phases: knowledge (awareness and understanding of the presence of an innovation), persuasion (positive attitude to the innovation), decision (engagement for its adoption), implementation (using the innovation) and confirmation (consolidating its use).

The second group represents intention-based theories that seek to identify user’s behavioural intentions, beliefs and predispositions about IS use. An example of this is the Technology Acceptance Model (TAM, cf. Davis, 1989) focussing on users’ sense of perceived ease of use and usefulness. This approach is based on the assumption that acceptance of an IS depends essentially on an individual user’s sense of its perceived “usefulness” and “ease of use”.

The third group, called the Resource Dependency Theory (RDT, e.g. Pfeffer & Salancik, 2003), considers how organizational units, including individuals, perceive “external” constraints as a construct of users’ interpretation processes. This leads users to decrease or increase their dependency on scarce and valued resources (as possible solutions) to overcome problematic constraints. To do this users establish social exchanges based on power relations and coalitions (for example through buffering and bridging strategies) to acquire and maintain key resources to satisfy perceived needs.

Within this context, the study of Díez & McIntosh (2009) raises the crucial question of how to assess IS use? Two broad processes can be identified, namely the pre- and post-implementation processes. Some researchers view post-implementation as an extension of initial implementation. In this vein, Liao, Chen & Yen (2007) propose intention-based theories as a guide to IS evaluation both at pre- and post-implementation phases.

Others, however, argue that evaluating IS use requires another approach. Thong, Hong & Tam (2006) put forward the Expectation Disconfirmation Theory (EDT) to assess continuing use of an IS based on the degree to which user's pre- and post-expectations concord. With these questions in mind Díez & McIntosh (2009) conducted a study based on the work of Jeyaraj, Rottman and Lacity (2006) to identify predictors of pre- and post- IS implementation processes. They found the best predictor of pre-implementation processes was user participation; the best predictor of organisational scale post-implementation was attributed to user satisfaction; and the best predictors of individual scale implementation were identified as subjective norms, perceived usefulness, behavioural intention, computer experience, system quality, upper management support, user support and user training (Díez & McIntosh, 2009, p.600). What this shows is the importance of factors such as *subjective norms*, *user participation*, *user satisfaction* and *user perceived usefulness*. These findings echo studies that point out that the growth of IS is in part due to the link between IS use and grassroots phenomenon such as *bricolage*, heuristics, serendipity, and make-do (Ciborra, 1998, p. 9). Similarly, Shing-Kao (1997, p.13) shows how users make different sense of what they see according to "their values, assumptions and expectations". It is with this in mind that our research framework was developed within a broad RDT framework, following Elias (1991) who reconciles individual "aspirations" to the dynamics of a social whole (see below).

## 2 Research framework

What is the study's originality for user-centred research methodology that underlies the Triadic Method – beyond the application domain of civil aviation (on this latter point see Annebicque, 2010)? To reply to this question our research framework is founded on a broad definition of an Information System as "sets of technical (scientific) and human resources devoted to the management of information in organizations" (Ciborra, 1998, p. 7).

A first corollary of this definition is the composite nature of an IS. Indeed, there seems to be a consensus that an IS, as a research domain, encompasses the interaction between data management of Information and Communication Technologies (ICT), on the one hand, and human and social processes associated with informational needs of users and organizations, on the other hand. The interaction between the technical demands of an ICT system (which acquires, stores, retrieves, processes, communicates and displays data) and the socio-cognitive needs of end-users involves the circulation and transformation of data associated with users' activities in a given situation.

A second corollary to Ciborra's definition is the observation that the concept of information is often limited to logical or physically measurable data. This quantitative idea of information lacks a key qualitative dimension about how users effectively make sense of IS data. For Ciborra (1998, p. 8, 15) it is this more qualitative aspects that is often a problem in IS use. He identifies the nub of the problem as the tendency of IS practitioners to borrow techniques from positivist "natural" sciences when observing, measuring and calculating IS use. In doing this, they overlook the role of human choice behind technical artifacts. To overcome this state of affairs, more ethnographic research, case studies and investigations into the more social aspects of computing would greatly enhance our understanding of IS use and implementation (cf. Walsham 1995, p. 74).

Given Ciborra's definition of an IS, and its corollaries, our research framework adopts a broad Resource Dependency Theory perspective (see above) with an emphasis on a qualitative "case study" (see below Section 3.2) approach. The framework is based on the founding work of Max Weber (1897), for whom the idea of "interpretive-understanding" (*Verstehen*) is a central element in grasping how humans interact in an environment and with cultural resources. The implications of "interpretive-understanding" for our study are threefold.

First, the researcher needs to grasp the over-arching “subjective sense” of what individuals, as cultural beings, appear to perceive as social reality. Secondly, understanding human interaction depends on establishing what the person does “regularly” as a social actor and agent. Thirdly, the consequences of human interactions, be they intended or not, need to be identified as part of a given social situation. Viewed in this way, the idea of interpretive-understanding can be understood in this paper as a *sense making* process that renders coherent a number of different meaningful elements for the user. Defined in this way, a sense making approach can provide “rich insights” (Walsham, 1995, p. 79-80, see below Section 3.2) about the values, assumptions and expectations of users interacting with an IS environment. How can this approach be put in practice when examining an air traffic controller’s decisional process based on data taken from a radar screen as a key tool of an Information System? This point is particularly important given the observation of Annebicque (2010, p.49-56) that there has been a dearth of qualitative research on air traffic controllers decisional process in the last 20 years.

For our study we accordingly adopted a qualitative interpretive research methodology to construct what we call, the Triadic Method. The Weberian-inspired methodology of the Method takes into account the work of sociologist Norbert Elias (1991) and psychologist George Kelly (1963). From this point of view the methodology differs from others who have developed Kelly’s approach, such as Curtis, Wells, Higbee and Lowry (2008) in IS, and design engineers working for NASA and BOEING who created a Design Alternatives Rationale Tradeoffs (DART) technique (cf. Gaines and Shaw, 1995).

The first axiomatic pillar of the Triadic Method is Elias’s argument that every society has its own history and culture that mould humans into singularly socialized individuals. This individualization process ensures that personal differences contribute to the co-construction of social norms and mores. In this regards, Elias does not see an opposition between an individual’s development and that of a socio-cultural whole, of which an individual is a member. The two are co-dependent. This dual dynamic applies to air traffic controllers. On the one hand, air traffic controllers, as highly skilled users of their IS, undergo strict selection and regular evaluations to ensure their compliance to the latest regulations and technical procedures. On the other hand, they are expected to make personal sense of social dynamics and mandatory air traffic norms in stressful situations, often demanding discretionary judgments. One such situation is the case of resolving flight conflicts (*i.e.* a potential aircraft collision) where air controllers have some leeway, notably when inundated with data in peak hours. An air traffic controller can thus be considered as being both a unique individual (with personal sense making skills based on an “interpretive-understanding” of a situation) and a legitimate representative of a strictly controlled profession. In this context, air traffic controllers are continually involved in negotiations with pilots and other air traffic controllers. Their daily tasks can be seen as increasing and decreasing dependencies on the availability of valued resources involving elements, such as flight paths, personal effort, space-time constraints and communication difficulties.

The second axiomatic pillar of the Triadic Method is the construing process of George Kelly’s (1963). In a nutshell, the definition of “construing” is considered as an abstractive and generalizing process where a person notes what two percepts have in common in contrast to a third percept (Kelly, 1963, p. 50).

Before we can count (1, 2, 3) we must construe their concrete difference from each other, their abstract likeness to each other, and their abstract difference to other things which are not to be counted. We must be able to construe where one thing leaves off and another begins, which one is similar enough to the others to be counted, and what is extraneous. What counts depends on what we abstract to be counted (Kelly, 1963, p. 54).

This process allows the individual to make sense of a series of perceived elements when three meaningful reference points inter-relate in their relative similarities (analogical reasoning, see below Section 4) and dissimilarities (diaphoric/contrastive reasoning). In wanting to make Kelly’s notion of

construing more operational to IS designers, this paper puts forward the following logically formalized statement:

$$\{[(x \sim y) \approx z] \rightarrow a_1\} \approx a_0 \mapsto C$$

where:

C is a “personal sense making construct” following l’explicitation of an *attribute of similarity*  $a_1$  (e.g. “Natural directive - S1”, see Figure 1 below) in diaphoric relation to  $(\approx)$  to an *attribute of dissimilarity*  $a_0$  (e.g. “No obvious solution - C1”, see Figure 1 below)

if and only if:

x (e.g. Flight Route 1, “R1”, see Figure 1 below), y (e.g. Flight Route 2, “R2”, see Figure 1 below) et z (e.g. Flight Route 3, “R3, see Figure 1 below) represent reference points within a given cluster perceived as meaningful given that:

- ~ means “is more or less similar to” (analogical reasoning)
- $\approx$  means “is more or less in contrast to” (diaphoric reasoning)
- $\rightarrow$  means “implies” (temporal relation)
- $\mapsto$  means “can be encapsulated as” (principle of parsimony).

It is within this framework that the Triadic Method was used to develop a case study research on how air traffic controllers manage the profusion of data when dealing with a probable air crash from a decisional perspective.

### 3 Research method

The entry point of the Triadic Method is axiomatic-inductive. The two axiomatic pillars of the research method were presented above. The inductive aspect of the method implies that there were no pre-established working hypothesis as to what the interviewee might or might not say and what this could mean for the researcher engaged in an exploratory semi-guided research interview.

This type of axiomatic-inductive approach allows the researcher to be receptive as to what interviewees have to say about their insights of their IS. As a qualitative research, the data in this study focuses on the personal sense that the interviewee ascribes to key words and ideas when deciding, in our case here, about how to formulate and resolved a flight conflict situation.

#### 3.1 Research objective

The research objective was to understand the decision making process of air traffic controllers during peak hours at France’s *Centre of Eastern En-Route Air Traffic Navigation* (CRNA EST) at Reims. (*En route* traffic controllers issue instructions to airborne aircrafts travelling between airports). One of the key tasks of air traffic controllers is to avoid air crashes. More precisely, controllers ensure a minimum distance between aircrafts is maintained and that they are on an appropriate flight path. It is in this context that a team of researchers in Decision Making Sciences and Social Sciences at the University of Valenciennes (France) sought to identify the personal values system that appears to guide air controllers’ choices when under pressure. The ultimate aim was to create a mathematical decision model (cf. Preference model of Roy 1985) for the creation of a digital decision aiding tool for an air traffic IS. The entry point of this study was the generation of qualitative data. To do this, the study made explicit the “subjective sense” that an air traffic controller accords to his/her everyday actions when faced with an aircraft conflict situation. The research problem was formulated in the following

way: In what manner and under what conditions can understanding an air traffic controller's decision process be supported by an Information System?

### **3.2 Case study method**

As Taylor & Todd (2001, p. 149-150) point out the identification of users' "subjective norms" in an interpersonal context can be an important determinant is self-report usage of an IS. To grasp these self declared "subjective norms" *via* a sense making decisional process approach a case study method was chosen. Schostak (2006, p. 21, 102) defines a case study as a single instance constructed by generating boundaries under given conditions in order to open up a domain for which it is difficult to formulate pre-established hypotheses. Bell, Bush, Fox, Goodey & Goulding (1984, p.76-77) stress that a key benefit of a case study is its ability to identify a "pattern of influences" that is not always discernible by traditional statistical analyses. For example, Dhillon, Caldeira and Wenger (2011) adopted a case study approach and found that the continuing use of an IS depends on "collective consent" through mutual adjustments between users' intentions, on the one hand, and power relations within an organization, on the other hand. A major challenge to this vision of case studies research is how to generalize with other "single instance" case studies? Walsham (1995, 79-80) answer to this thorny problem is to outline four ways in which such generalization can be done: the development of structured "concepts", the generation of a coherent "theory", the drawing up of clear "recommendations", and the presentation of a "rich insight". It is this last point that guided our study (see below Section 3.3).

On a more procedural level, at the heart of a case study are the criteria for selecting an interviewee. This needs to be done in such a way that it allows the interviewee to be identifiable in a non-trivial manner with other social actors in comparable conditions. The interviewee of our case study was chosen because he underwent the same strict selection, training and regular evaluation as other air traffic controllers in France. In this case, the interviewee – whom we shall call Loïc – had 10 years of experience in air traffic control and is also an air traffic control instructor. This ensured he had a good grasp of grassroots practice with added experience as an instructor and evaluator of colleagues.

### **3.3 Research protocol**

A researcher conducted an 80 minute, semi-guided interview involving three Aircraft Traffic Controllers. For this paper, the Controller chosen was selected because of his greater experience than his other colleagues. Loïc was interviewed in an office at his place of work where there was a table, a chair, a mini digital tape recorder and a computer screen with a radar screenshot of an air traffic conflict, *i.e.* two aircrafts flying at the same altitude and on a collision path amidst a series of other aircrafts on their respective flight paths. (The radar screenshot represents a predominant aspect of the air controllers' IS, see Figure 1). The proposed conflict occurs at the flight beacon VELIN between two aircrafts, called respectively BAL632 (top left) and KLM1884 (top right). The two aircrafts are separated by only 60 seconds. The minimal time of separation is normally 180 seconds.

Aircraft BCS1080 (its flight path is represented as a straight line, south to north, see Figure 1) crosses the trajectory of aircraft BAL632. Aircraft AFR1657 (its flight path represented as dots, north to south) follow the path of aircraft KLM1884. (The conflicting flight path is put in bold, with a dotted arrow indicating the VELIN beacon). KLM1884 will be the first to reach the VELIN beacon. Three other aircrafts are also present and represent a constraint to resolving the conflict. In fact, aircraft AEL2789 (whose flight path is represented in dots from west to east) crosses the trajectory of aircraft BAL632 followed by aircraft KLM1884 before crossing the VELIN beacon. Once the researcher had explained the conflict situation, Loïc was offered six possible routes (denotated as "R") as possible solutions (R1 to R6, see Table 1 below) to the conflict problem. Each solution is based on current

practice and has implications on the reliance on an IS to control resources and the controller's preference in handling an imminent crisis in a limited time frame (see Annebicque 2010). When Loïc had studied the solutions and validated them as credible in a real life situation, he was asked to explain exactly how he would resolve the conflict. In short, the six alternative routes are not speculative or hypothetical propositions but meaningful options for an air traffic controller.

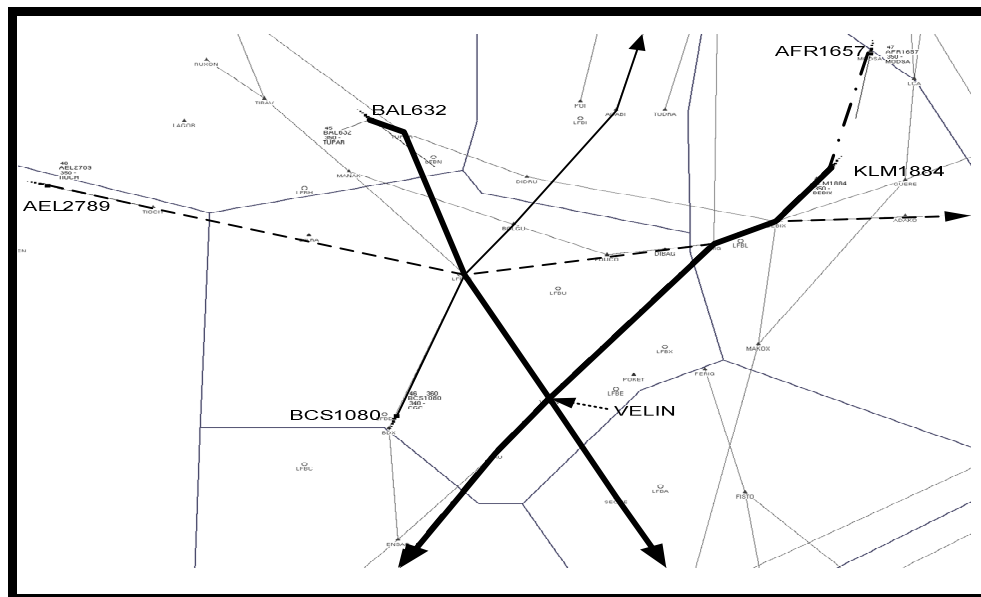


Figure 1. Two aircrafts on a conflict path

The guided interview that ensued was directed by a step by step filling in of a triadic grid sheet (see Table 1 below) in dialogue with the researcher. The grid sheet is an essential tool to encourage the interviewee explicate and then crystallize his/her thoughts. In this study, the triadic grid sheet is filled in five basic phases.

**Phase 1.** The six possible solutions to a problem (R1 to R6) are placed next to each other vertically in columns. The solutions are presented to the interviewee in clusters of three solutions, along with the radar screenshot. This three-item clustering limits possible cognitive overload. Presented in this way, the interviewee explains what two of the solutions have in common that the third solution does not possess (this is called a construing process).

**Phase 2.** After the interviewee has identified similarities between two possible solutions, which the third solution does not have, the person finds a keyword to summarise his/her point of view (“S” see below). The word is discussed with the researcher and then noted down to the *left* of the six-solution columns (see Table 1). As the interview advances, other words are found and listed vertically one under the other. When the interviewee has exhausted what can be said about the three-solution cluster (e.g. R1, R2, R3, see Table 1), the cluster is changed by replacing one solution (e.g. R1) with a new solution (e.g. R4) not yet examined. The process stops when the interviewee has nothing left to say (saturation principle) when construing the similarities and dissimilarities of all the possible solutions.

**Phase 3.** To the *right* of the vertical solution columns, the interviewee establishes what s/he considers as the attribute that contrasts (e.g. “C1” see below) to each corresponding similitude-attribute (e.g. “S1”) on the left side of the grid.

**Phase 4.** When all the contrast-words have been established, the interviewee further explains his preferences by a numeric five-point scale. The preference is established by comparing each of the six possible solutions (vertical dimension) with each pair of words (horizontal dimension) line by line.



The value of “1” of the five-point scale represents a strong preference for the similarity-word on the left of the triadic grid, while “5” indicates a strong preference for the contrast-word on the right. Between these two extremities, the “2” designates a relative preference for the similarity-word (on the left) and “4” indicates a relative preference for the contrast-word (on the right). The value of “3” expresses an undifferentiated preference.

**Phase 5.** In concluding the interview, the researcher asks the interviewee to indicate which of the six solutions s/he prefers, by putting an “X” on his choice. This is similarly done for each word of the similitude-contrast dyad, *i.e.* the interviewee chooses if s/he prefers either the similitude or the dissimilarity/contrast word. This final phase helps clarify the values underlying announced preferences. The interpretation of the triadic grid is inspired from the work of researchers like Ashleigh and Nandhakumar (2007).

	<del>R1-BAL 632 to KLM 1884</del> <del>R2-KLM 1884 to BAL 632</del> <del>R3-Double direct BCS - S3</del> <del>R4-BAL 632 to KLM 1884</del> <del>R5-BAL 632 to AFR 1657</del> <del>R6-Change altitude</del>						
<del>Natural directive - S1</del>	1	2	1	4	5	4	C1 - No obvious solution
<del>Keep to original route - S2</del>	1	2	1	2	5	1	C2 - Change route
<del>More space for flight BCS - S3</del>	1	2	3	4	1	3	C3 - Bring closer for flight BC
<del>Slight direction change - S4</del>	2	3	1	2	5	3	C4 - Significant direction change
<del>At start of sector - S5</del>	3	3	3	5	2	1	C5 - At end of sector
<del>Early solution - S6</del>	3	3	2	4	4	1	C6 - Late solution
<del>Rapid solution - S7</del>	2	3	1	5	5	2	C7 - Time consuming solution

Table 1. Triadic grid of an air traffic controller

## 4 Findings and discussion

To understand the contribution of the Triadic Method from a practical methodological point of view it is necessary to go into some brief details about the impact of our approach on how an air traffic controller makes sense of IS related data in controlling dependencies on resources, *via* for example personal effort, space-time constraints, difficulties in exchanges with pilots and other air traffic controllers. A study of the triadic grid shows how when an IS user, like the air traffic controller, Loïc, observes an apparent conflict in his sector, he isolates the problematic aircrafts from the rest of the traffic. The data needed to do this safely and efficiently is found in IS related data like the flight progress strip board, radio exchanges, the radar view and suggestions from colleagues. In Kelly’s terms, Loïc has “construed” a first level of clustering. This is done by the air traffic controller relying on his IS to inform him at the appropriate moment what aircrafts in his sector have in common, or not, in terms of speed, direction, altitude and distance to each other. When this initial framework is in place, Loïc evaluates “what is happening here and now” on his radar screen to re-establish an overall coherence in the traffic flow. This corresponds to a series of compensation and amplification

instructions given by an air traffic controller to pilots regarding distances between aircrafts and flight paths. The process highlights the need for the air traffic controller to obtain appropriate data in order to create an anticipatory sense making framework.

An examination of the interview verbatim reveals that Loïc's explicitly favours (cf. Phase 5 of the interview) the similarities column ("X" put on the left-hand side of the grid). Understanding Loïc's value system becomes a lot clearer when the contrast (dissimilarity) words (on the right-hand of the grid) are examined (cf. Phase 3 of the interview). Even if Loïc's declared preference is strongly in favour of solution R1, as the "X" put by him indicates (cf. Figure 1), it seems he was "initially" tempted by the R6 (Change altitude) solution as the number of "1s" and a "2s" scores indicate (*i.e.* attributes S2, S5, S6 and S7, cf. Figure 1). What then was the reference point that Loïc used to finally opt for Route 1 (R1) instead of Route 6 (R6)? It is in such deadlocks situations that the Triadic Method can offer "rich insights" into the more implicit aspects of a user's sense making process.

A closer look, however, at the contrastive attributes (to the right of the triadic grid), which were ostensibly not part of Loïc's preoccupation, indicates how the possible solution R6 served as a "sounding board". This reveals a heuristic, among traffic controllers, that favours flight routes that involve a minimum impact on the general traffic flow and on the energy required to handling the consequences of a decision that changes a flight path. In this case changing the direction of an aircraft (while maintaining the altitude) – rather than keeping the direction but changing the altitude – is seen as a way of managing personal energy resources of an air controller. Given this, Loïc's decision is clear – solution R1 (Route 1) corresponds more closely to his value system of what he deems to the "natural" choice (attribute S1, cf. Figure 1) in this situation. Future development of an IS for Air Traffic Controllers needs to take such heuristics (favouring change in flight direction rather than altitude) into account when seeking to help crystallise a Controller's final decision.

Loïc's decisional process underlines the efficacy of the Triadic Method in providing a "rich insight" of how IS users can make sense of their actions. It highlights how the process of filling in a triadic grid can bring out the "subjective sense" of an IS user, notably concerning the reference point used in a methodic elimination of potential choices in a decision process. According to Annebicque (2010) this is not common practice in research about how air controllers' effectively use IS related data, notably to show how they disconfirm feasible choices when resolving pressing problems – rather than opting for the first apparent solution (*e.g.* Route 6). It needs to be said that even if air traffic controllers are highly trained to respect norms, there may be a discrepancy between what they say they do and what they really do in reality. That said *in situ* observations of Annebicque (2010 p. 186-195) show a strong correspondence between what air traffic controllers say they do in a Triadic Method interview situation and what they do in practice.

Loïc's decisional process of looking beyond the initial apparent solution, effectively qualifies a certain interpretation of Newell and Simon's (1972) hypothesis of "limited rationality", whereby decision makers tend to opt for the first appropriate ("satisfactory") decision they come across. The authors argue that the human problem solving process tends to favour a "satisfactory" decision rather than an "optimal" one if the latter appears to take too many resources, for example in time, cost or effort. If indeed a "decision is a matter of compromise » (Simon, 1997, p. 77), then understanding the nature of this compromise is at the heart of what the Triadic Method seeks to shed some light. In this case the Method clarifies on what basis a user, like Loïc, takes his decision when using an IS to control resources, in this case in conserving the supervision effort of the air traffic controller and the comfort of pilots.

In this way, our study effectively spotlights the prominent role that an IS can play in a user's overall decision process. This includes air traffic controllers contacting pilots to give instructions and negotiating over the telephone with controllers of adjoining air navigation sectors about the feasibility of changing flight paths. The latter point has implications for future developments of inter- and intra-

organisational levels in coordinating the actions of different air controllers and pilots as users of a shared IS from an Resource Dependency Theory angle. The Triadic Method could significantly contribute to clarifying how the working culture of rank and file users deploy resources and organise “power relations and coalitions” based on rarely avowed “*bricolage*, heuristics, serendipity, and make-do” practices (Ciborra, 1998). For example, our present study raised the question of the role of the present paper format of a flight progress strip (a summary update of an aircraft’s flight plan) compared to an electronic format from an IS perspective. Although beyond the scope of this paper, the Triadic Method was able to provide a brief insight into this question by highlighting the user’s “values, assumptions and expectations” (Shing-Kao, 1997 see above) about the some of the issues involved between a paper- and an electronic-flight progress strip.

The observations drawn from the study also brings out the need for future developments in ISs *via* approaches such as the Triadic Method. This includes a closer examination of an organisation’s culture for example, by asking different users to examine different triadic grids (filled in by other users) to suggest alternative interpretations of the data within their respective organisational context. This would coincide with Agourram (2009) and Jackson (2011) who argue that the organizational culture of an organization can have a determining effect on IS adoption. Agourram (2009, p. 135) stresses the importance of qualitative research in the IS domain, notably in the creation of grounded data in their corresponding contexts, notably concerning user’s perception of their IS. In this context, Jackson’s (2011, p. 80) study about IS adoption shows how an organisation’s culture invariably influences an individual’s actions and perceptions due to ever changing pluralistic and competitive social relations, which are at best, partially controllable and predictable.

Our research methodology into a decisional process has implications for a current research project, called SAMOSA, concerning how airport passengers make sense of undergoing whole-body millimetre wave scanning to detect objects they may have concealed under their clothing. A working hypothesis for this project is that it could be useful to establish what series of choices passengers consider in terms of their value systems, before arriving at a final decision to be scanned or not. The question then is under what conditions passengers could be persuaded to temporarily suspend an initial decision – when deciding to be scanned, or not – in considering choices they may not have (fully) considered?

From a more conceptual point of view, methodologies, such as those of the Triadic Method, need to explore the intricate relations between “analogical reasoning” (Gentner & Colhoun, 2010) and “diaphoric reasoning” processes (Floridi, 2010). For Floridi, *diaphora* (“difference” in Greek) is at the basis of perceived information created through a *datum*, *i.e.* is a putative observation regarding a “lack of uniformity” in a given situation. In the methodological dynamics of the Triadic Method, this *diaphora* is construed in relation to users’ perceived analogous similarities.

Analogical processes are at the core of relational thinking, a crucial ability that, we suggest, is key to human cognitive prowess and separates us from other intelligent creatures. Our capacity for analogy ensures that every new encounter offers not only its own kernel of knowledge, but a potentially vast set of insights resulting from parallels past and future (Gentner & Colhoun, 2010, p. 2).

The logic between the analogical and diaphoric processes is, however, not always clear from a qualitative informational perspective. For example, are the links between the two processes mutually causal or is one of the processes more insight-generating as Genter and Cohoun (2010) suggest concerning analogical-based thinking? How can these processes clarify “buffering” and “bridging” strategies when identifying external constraints and obtaining/using valued resources, notably on an individual decision making level? Such issues need further study from a methodological point of view within an IS perspective.

Another development area concerning the Triadic Method, involves alternative analysis of the numeric matrix of the triadic grid to reinforce the robustness of the interpretation of the data. This could provide a basis of comparison between case studies beyond traditional Cluster Analysis and Primary Component Analysis. One promising domain of development in reanalysing the triadic grid is the mathematics of social choice theory where individual values and preferences are aggregated towards collective decision making (cf. Arrow, 1977).

Future research is needed on implementation and use of IS related tools to deepen our “interpretative-understanding” of organisational (e.g. Weick, 2009) and individual user (e.g. Dervin, Foreman-Wernet & Lauterbach, 2003) sense making processes by studies that take into account different factors and different forms of qualitative and quantitative methods. This would allow a cross-referencing of perspectives to increase the robustness of observations and their implications for research and operational practice.

## 5 Conclusion

In this paper a novel interpretive research methodology, called the Triadic Method, was presented *via* a case study research about the sense making process of how an air traffic controller says he resolves air traffic conflicts when using an IS to control resources in exchanges with pilots and other air traffic controllers. The aim was to show the methodological implications for the IS domain beyond the application domain of civil aviation.

The study was conducted by a semi-directed interview focussed on a dialogical process of filling in a triadic grid. The originality of the Triadic Method is twofold. First, its basic logic can be logically formalised for the development of an IS framework. Second, this study of the Triadic Method provides a methodological basis into understanding users’ sense-making processes and value systems for research projects like SAMOSA concerning the pre-implementation of whole-body millimetre wave imaging scanners to detect objects underneath a passenger’s clothing in French airports.

Besides understanding the contribution and limits of individual users and organisational participation in IS development a useful point of entry for future research could focus on better identifying the gap between *perceived system quality* of end-users, on the one hand, and *desired system quality* of upper management, on the other hand, when analyzing Information System use and development. It is posited that the Triadic Method can contribute to clarifying to what extent such gaps are present and in terms of what factors they exist. This could provide valuable input, for example, when organising “upper management support, user support and user training” (Diez & McIntosh, 2009, p. 600) as key elements of individual scale implementation.

## References

- Agourram, H. (2009). Defining information system success in Germany. *International Journal of Information Management*, 29, 129–137.
- Annebicque, D. (2010). *Apport de l’aide à la décision à la coopération Homme-machine. Application au contrôle du trafic aérien*. Unpublished doctoral thesis. University of Valenciennes (France).
- Arrow, K. (1977). *Social Choice and Individual Values*. Yale University Press, Yale.
- Ashleigh M.J. & Nandhakumar J. (2007). Trust and technologies: Implications for organizational work practices. *Decision Support Systems*, 43(2), 607-617.
- Bell, J., Bush, T., Fox, A., Goodey, J. & Goulding, S. (1984). *Conducting Small-Scale Investigations on Educational Management*. Paul Chapman Publishing, London.

- Ciborra, C.U. (1998). Crisis and foundations: an inquiry into the nature and limits of models and methods in the information systems discipline. *Journal of Strategic Information Systems*, 7, 5-16.
- Curtis, A.M., Wells, T.M, Higbee, T. & Lowry, P.B. (2008). An Overview and Tutorial of the Repertory Grid Technique in Information Systems Research. *Communications of the Association for Information Systems (CAIS)*, 23 (3), 37-62.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-339.
- Díez, E. & McIntosh, B.S. (2009). A review of the factors which influence the use and usefulness of information systems. *Environmental Modelling & Software*, 24, 588-602.
- Dervin, B., Foreman-Wernet, L. & Lauterbach, E. (2003). *Sense-Making Methodology Reader: Selected Writings of Brenda Dervin (Communication Alternatives)*, Hampton Press, New York.
- Dhillon, G.S, Caldeira, M. & Wenger, M.R. (2011). Intentionality and power interplay in IS implementation: The case of an asset management firm. *Journal of Strategic Information Systems*, 20, 438–448.
- Elias, N. (1991). *The Symbol Theory*. Sage, London.
- Floridi, L. (2010). *Information. A very short introduction*. Oxford University Press, Oxford.
- Gaines, B. R. & Shaw, M. L. G. (1995). *Knowledge Acquisition Tools based on Personal Construct Psychology*. Knowledge Science Institute, University of Calgary Alberta (Canada).
- Gentner, D., & Colhoun, J. (2010). Analogical processes in human thinking and learning. In A. von Müller & E. Pöppel & B. Glatzeder, V. Goel, & A. von Müller. (Eds). 2010. *On Thinking: Vol. 2. Towards a Theory of Thinking*. Springer-Verlag, Berlin. pp. 36-48.
- Heidegger, M. (1977). *The Question Concerning Technology and Other Essays*. Harper & Row, New York.
- Kelly G.A. (1963). *The Psychology of Personal Constructs*. Norton, New York.
- Jackson, S. (2011). Organizational culture and information systems adoption: A three-perspective approach. *Information and Organization*, 21, 57–83.
- Jeyaraj, A., Rottman, J.W., & Lacity, M.C. (2006). A review of the predictors, linkages, and biases in IT innovation adoption research. *Journal of Information Technology*, 21(1), 1–23.
- Labour, M. (2011). *MEDIA-REPERES. Une méthode pour l'explicitation des construits de sens au visionnage*. Unpublished post-doctoral dissertation. University of Valenciennes (France).
- Liao, C., Chen, J.L., & Yen, D.C. (2007). Theory of planning behaviour (TPB) and customer satisfaction in the continued use of e-service: an integrated model. *Computers in Human Behaviour* 23 (6), 2804–2822.
- Newell, A. & Simon, H.A. (1972). *Human Problem Solving*. Prentice Hall, Englewood Cliffs.
- Pfeffer, J. & Salancik, G.R. (2003). *The External Control Of Organizations: A Resource Dependence Perspective*. Stanford University Press, Stanford.
- Rogers, E.M. (1995). *Diffusion of Innovations*. Free Press, New York.
- Schostak, J. (2006). *Interviewing and Representation in Qualitative Research*. Open University Press, Berkshire.
- Simon, H. A. (1977). *Administrative Behavior*. The Free Press, New York.
- Shing-Kao, L. (1997). *A study of national culture versus corporate culture in international management*. Davie (FL), Nova Southeastern University.
- Taylor, S & Todd, P.A. (2001). Understanding information technology usage: A test of competing models. *Information Systems Research*, 6(2), 144–176.
- Thong, J.Y.L., Hong, S.J., & Tam, K.Y. (2006). The effects of post-adoption beliefs on the expectation-confirmation model for information technology continuance. *International Journal of Human-Computer Studies*, 64(9), 799–810.
- Walsham, G. (1995). Interpretive case studies in IS research: nature and method. *European Journal of Information System*, 4, 47-81.
- Weber, M. (1897). Objectivity in Social Science. In W. Heydebrand. (1994). *Max Weber, Sociological Writings*. Continuum, New York.
- Weick, K. (2009). *Making Sense of the Organization: Volume 2: The Impermanent Organization*. John Wiley & Sons, Chichester.