ECustoms Case Study: Mechanisms behind Co-operation Planning

María Laura Ponisio¹, Pascal van Eck¹, Lourens Riemens²

¹ Department of Computer Science, University of Twente
F.O. Box 217, 7500 AE Enschede, The Netherlands
ml@ponisio.com,

p.vaneck@utwente.nl

² Dutch Tax and Customs Administration
Apeldoorn, The Netherlands
lj.riemens@belastingdienst.nl

ABSTRACT

Members of existing e-commerce trading networks constantly assess their network to identify opportunities for increased co-operation and integration of e-commerce IT systems. Failing to identify the mechanisms involved in co-operation compromises correct investment decisions. In this paper, we use Systems Thinking as a reasoning model that helps decision makers to uncover such mechanisms. We use Systems Thinking to analyse a real-world case called eCustoms, an inter-organisational network of customs organisations. The resulting model explains the mechanism of planning co-operation in terms of a feedback loop that comprises political support, operational potential, and information flow. This mechanism also explains why it is important to select potential partners for closer co-operation as early as possible, the importance of willingness to participate, and the gain or loss of decision power that joining a network implies.

KEYWORDS

Systems Thinking, Systems Dynamics, Inter-organisational networks, management practices.

1. INTRODUCTION

Business-to-business e-commerce is supported by inter-organisational networks. These networks consist of information technology (IT) systems that support co-operation between trading partners, for instance in long-term strategic supply partnerships. Therefore, in e-commerce, understanding how co-operation works is essential to make correct investment decisions.

Members of an established trading network constantly assess their network to identify partners with whom to increase co-operation, for instance to further integrate their e-commerce systems. Part of the problem is to identify other members that may be interested in closer co-operation early in the network formation process. There are several challenges in planning this co-operation process (Ponisio, Sikkel, Riemens and van Eck, 2007, 2008): possibilities for opportunistic behaviour (Williamson, 1993) have to be mitigated, potential partners must be assessed considering multiple perspectives, attention has to be paid to distribution of power in the network, the IT development process has to be planned, and sustainable gains have to be measured. The importance of such challenges is illustrated for instance in the well-known case of Covisint (Gerst and Bunduchi, 2005, 2007), where sub-optimal attention for power issues resulted in near-total failure. However, current systems development theories in e-commerce insufficiently address these challenges. An undesired consequence is that in practice, co-operation planning is done ad-hoc.

Copyright 2008 IADIS Press. This is a pre-print version.
Decision makers, therefore, ask for techniques that help them to uncover the mechanisms that determine successful co-operation. Uncovering such mechanisms should help experts to understand the forces and tensions involved, which should improve planning co-operation. For instance, which network partners to choose for further integration, on which topic to co-operate, and which additional systems to integrate first with existing partners?

This paper presents a study of eCustoms (Section 3); a real-world case of an established inter-organisational network in which customs organisations of the European Union (EU) co-operate electronically to improve ensuring safety of the EU external borders, and to facilitate trade. Members states of the EU form bilateral or multilateral relations within the boundaries of this network in which IT systems are integrated. All these relations together shape the eCustoms network. Each relation is constantly evolving, having their supporting IT systems (and their architectures) evolving too.

In this paper, we use Systems Thinking (Section 2) as a reasoning tool to explain the mechanisms behind co-operation planning. In particular, we are interested in uncovering the mechanisms that influence the choice of partners for intensified co-operation. Systems Thinking is a holistic problem solving method in which system behaviour emerges from the interaction of system components. Recent research proved the potential of using the Systems Thinking approach to explain mechanisms behind IT outsourcing projects (van Eck and Ponisio, 2008). This paper extends our earlier studies of electronic customs (Ponisio, Sikkela, Riemens and van Eck, 2007, 2008; Ponisio, van Eck and Riemens, 2008).

Being able to reason in terms of such dynamics helps project managers to plan co-operation in inter-organisational networks. The contribution of this paper is a Systems Thinking model that enabled us to identify causal loops in the mechanisms that play a role in co-operation planning (Section 4). We show how applying Systems Thinking helps the e-commerce network stakeholders to explain the rationale behind planning co-operation in inter-organisational networks. A better understanding of the dynamics enables decision makers to avoid surprises and instead predict the consequences of the planning actions they take. For instance, the Systems Thinking approach uncovered the need to anticipate exit strategies by adding an exit clause to the contract.

In the case study, our findings indicate the importance of willingness (supported by, e.g., matching goals and matching needs), the importance of entering (or leaving) the co-operation network early, and that joining a closely co-operating group has – in addition to the benefits of working as a group – the potential to, in practice, lose decision power (because participants need to account for others in their decisions). We explain this using a concrete example of partner selection in eCustoms. We validate our findings via interviews with experts and conclude by presenting implications for research and practice.

2. SYSTEMS THINKING: BACKGROUND

Systems Thinking (Midgley, 2003) analyses a system by modelling the relations between the components of the system and studying the behaviour that is jointly created by the interactions between these components. This creates a holistic view of the problem that helps to identify the dynamics of the system that results from interactions between its components. These dynamics would remain hidden in an analytic approach in which system components are studied in isolation.

In previous work (van Eck and Ponisio, 2008), we have applied Systems Thinking in the domain of IT outsourcing projects. In that work, we observed that project outcome is not determined at a single moment in time only, e.g., at the end of the project, but by a process consisting of multiple interactions with members of the customer organization during the entire project. We developed a causal model (Figure 1) that explains the dynamics of project outcome. Outsourcing creates a relation between two economically independent actors (the outsourcer and the insourcer). The fact that the two actors are economically independent creates forces and tensions between them that in turn influence delivery quality as depicted in the model (words in italics refer to variables in Figure 1). During the project, both employ information flows to coordinate their activities. This information exchange, however, is influenced by the trust that they have in each other, which in turn is influenced by the perception of the outsourcer of the extent to which the insourcer is capable of delivery. As both actors are economically independent, we have to assume that each is self-interested and not unwilling to act in a way that advances its own interest in a way that is detrimental to the other (possibilities for opportunistic behaviour).

Copyright 2008 IADIS Press. This is a pre-print version.
The dynamic model shows that in outsourcing, there are at least two positive, or reinforcing, feedback loops which explain why outsourcing projects have a tendency to get out of control: for instance, if trust erodes, parties become less open in their communication, which affects delivery, which in turn further erodes trust, and so on. Of course, the feedback loop can also work in the opposite direction: if trust increases (for instance, by decreasing opportunism), eventually delivery quality will increase, which in turn increases trust further. The point is that the feedback loops make the dynamic aspects of the project explicit. This is the primary benefit of applying the Systems Thinking perspective.

The model depicted in Figure 1 follows the so-called qualitative Systems Dynamics paradigm (Sterman, 2000). Like all Systems Thinking paradigms, Systems Dynamics models a system as the interplay between its parts (holism). Systems Dynamics (pioneered by Forrester (1989) and rooted in general mathematical systems theory) focuses on modelling feedback loops consisting of cause-and-effect relations between system components. In qualitative Systems Dynamics, this model is then validated via expert review. In quantitative Systems Dynamics, computer simulations are used to study system dynamics and validate the model. Systems Dynamics primarily deals with quantitative models, but as early as 1983 qualitative approaches have been proposed (Wolstenholme and Coyle, 1983; Wolstenholme, 1983).

Both quantitative as well as qualitative Systems Dynamics are what Pollack (2007) calls ‘hard’ approaches to systems thinking: the systems model is seen as an objective, true representation of the real world, and stakeholders agree on a “clear and single dimensional (single objective)” problem definition (Maani and Cavana, 2000). In ‘soft’ approaches (of which Peter Checkland’s Soft Systems Methodology (Checkland, 1981) is probably the best-known example), the dynamic model is not seen as an objective representation of the real world, but as “a way of generating debate and insight about the real world” (Maani and Cavana, 2000). A ‘soft’ approach has been used by Johnstone et al. (2006) to develop a holistic framework of conflict and conflict resolution in IT projects.

Figure 1. Operational success of outsourcing: causal model (van Eck and Ponisio, 2008). A ‘+’ indicates that an increase in one variable causes an increase in the other. A ‘−’ indicates that an increase in one variable causes a decrease in the other. Two ‘reinforcing’ (letter ‘R’) feedback loops are indicated.
3. PLANNING CO-OPERATION IN INTER-ORGANISATIONAL NETWORKS

In this paper we use Systems Thinking to understand inter-organisational networks. In particular, to plan closer co-operation among members of an established inter-organisational network: one formed by customs organisations of the EU. Specifically, network participants need to connect their supporting information systems to improve information flow and to efficiently automatise security checks and paperwork through their borders. Part of the problem is to find ways to help experts (a) find other members that might be interested to co-operate and (b) learn on what topic it is better to collaborate.

3.1. Defining inter-organisational networks

We define an inter-organisational network as a network of organisations which jointly support value-creating processes (Ponisio, Sikkel, Riemens and van Eck, 2007, 2008). Information flows between the participating organisations. The goal of the network is some result of that flow of information.

Each organisation in the network uses a set of information systems (i.e., computer hardware, application software, datasets and possibly manual procedures) to process the information flows mentioned. This set of information systems (the IT portfolio of the organisation) includes both organisation-specific information systems as well as general IT infrastructure components (e.g., email servers).

3.2. eCustoms: an example of an inter-organisational network

eCustoms is a representative example of an inter-organisational network as defined in this paper. eCustoms is a network of customs organisations of the 27 member states of the European Union (EU). The network was created in reply to the EU’s aim to facilitate trade and improve ensuring safety of the external borders of the union. Customs organisations of all 27 member states of the European Union have to act as if they form one virtual customs. The network has been in place for many years, but new demands make it necessary for members to co-operate in order to fulfil these demands.

3.3. Existing approaches to plan eCustoms

The Dutch Tax and Customs Administration conducted between January 2005 and October 2005 a study that compared current organisational context, business processes, systems and future ambitions of ten member states (Netherlands Tax and Customs Administration, 2005). This sample of ten member states is a good one for this paper because it is heterogeneous, representing both large and small countries. This study – called “Benchmarking Customs IT Architecture” – showed the customs networking profiles of each country, providing high-quality data suited to analyse opportunities for co-operation. In fact, this study solved the problem of lack of information required to find opportunities for co-operation.

We have read the benchmarking report and used its data as one of the sources of our data collection. The benchmarking study performed by the Dutch Tax and Customs Administration provided a wealth of quantitative data about potential co-operation partners, the analysis of “with whom to co-operate” was performed on an ad hoc basis. To facilitate understanding, in an earlier paper we developed an approach that combines two types of graphical snapshots of the member customs’ relevant properties (Ponisio, Sikkel, Riemens and van Eck, 2008). The result was a visualisation model based on quantitative data that increased understanding of opportunities and challenges in IT integration.

A further attempt to optimise planning in eCustoms consisted of using critical problem solving (Ponisio, van Eck and Riemens, 2008). The goal was to present a systematic approach to plan co-operation between customs organisations and the approach was called e-Planning. It consisted in an action plan for customs IT decision makers to decide how to order the steps in the process. e-Planning follows the engineering cycle (Wieringa, 2007) to discover questions that are relevant in a particular scenario. e-planning provided an approach to systematically detect significant co-operation issues, but did not uncover the mechanisms that help decision makers explain the rationale behind their decisions.

Copyright 2008 IADIS Press. This is a pre-print version.
3.4. Our approach: Using Systems Thinking to extend the benchmarking study

The previous approaches to improve planning in eCustoms offered solutions to the problem in terms of measuring, visualising and planning, but did not uncover the dynamic mechanisms that explain why some partners are preferred over others. To mitigate this, in this paper we use Systems Thinking to emphasise the dynamics existing in developing inter-organisational networks. This means that we view the eCustoms network as a system, consisting of a number of member states of the EU, their internal organisation, decision making procedures, and supporting information systems. These are the components that interact to create the overall behaviour of the system. In the Systems Thinking approach, we identify properties of these components as well as relations between these properties. To the best of our understanding our approach is novel: to use Systems Thinking to planning co-operation in inter-organisational networks (specifically in eCustoms) has never been tried before.

Specifically, in this paper we use an interpretive case study approach (Klein and Myers, 1999) guided by Systems Thinking. We interpreted the data provided by the benchmarking case study, other documents and interviews with customs experts in terms of the dynamic model presented in Figure 1. We studied the outcome of the benchmarking case study and the other studies looking for similar feedback loops as depicted in the dynamic model, addressing the following two questions:

1. Which data present in the eCustoms case study are causally related to co-operation success potential? This data represents the properties of the underlying system that are of interest. The value of these properties are represented by variables that potentially are part of any feedback loops.

2. What exactly are the causal relations between the variables that we thus uncover?

The next section gives an account of how we applied the Systems Thinking view in eCustoms to answer these questions.

4. A CAUSAL MODEL OF PLANNING CO-ORDINATION IN ECUSTOMS

In the case study, we applied Systems Thinking to the data collected (e.g., the data provided by “Benchmarking Customs IT Architecture” and the interviews with experts). We reasoned about co-operation planning in a systematic way: we re-interpreted the general causal model (Figure 1) for outsourcing in the context of the eCustoms case study.

From this analysis we selected variables to include in the systems thinking model. A variable is included in the model if (i) the variable is involved in an important causal relation and (ii) the variable can be controlled by project managers in real-world situations. The resulting variables and relations together form the eCustoms dynamic model. This model may contain one or more feedback loops, but these feedback loops need not be the same ones as depicted in Figure 1. To the contrary, as the model of Figure 1 is for a situation (software development in outsourcing) that is not the same as in eCustoms, most likely the dynamic model for eCustoms will not be exactly the same. However, the kind of mechanism depicted by the model for outsourcing served as a blueprint for the kind of mechanism that we wanted to uncover in the eCustoms case.

The resulting causal model is depicted in Figure 2. The model represents the properties of a potential co-operation between two countries in the eCustoms network. These properties are used to analyse the benefits of co-operation. The properties are case dependent; they are the variables that we derived from documents describing a specific co-operation planning case.

In line with Systems Thinking, we view this co-operation as a system. Components of this system are the two participating countries, their goals and needs, their IT systems and data exchange infrastructure, etc. These components have properties that are represented in the model. In the interest of readability, our diagrams have clusters and global arrows. A cluster groups related variables. Our shorthand for having an arrow to or from all the variables in a cluster is to have one arrow to the cluster of variables.

The next subsections systematically describe the variables in the model as well as the relations between them. We conclude by explaining concrete examples in terms of the feedback loops in the model.

Figure 2. Systems Thinking model to reason about opportunities and potential problems in planning co-operation within the eCustoms network.

4.1. Cluster 1: Political support

Cluster 1, called ‘Political Support’, consists of three variables that are roughly equivalent to two variables in the general outsourcing model (Figure 1) ‘Trust of O in I’ (top) and ‘Trust of I in O’ (centre).

- Matching goals: extent to which the goals in the area of the co-operation topic of the two countries match.
- Matching needs: extent to which the needs in the area of the co-operation topic of the two countries are matching (e.g., similar, or complementary)
- Image to the world: the extent to which the two countries are able to expose a modern image to the world that shows that they are oriented toward supporting co-operation.

These variables are dimensions of the extent to which and decision makers at the political level of the two potential trading partners provide support for the co-operation in terms of allocating resources. They can be interpreted as the ‘willingness’ to co-operate. Thus, political support is broader than just trust.

4.2. Cluster 2: Information Flow

Cluster 2, called ‘Information Flow’, consists of two variables that play a similar role in eCustoms as ‘delivery quality perceived by O’ (far right hand side of Figure 1) and ‘Effective coordination’ (just left of ‘delivery quality perceived by O’) in the general outsourcing model. In the eCustoms case study, we focus on quality of information exchange, not on the more general concept of an outsourcer’s perception of project

outcome (quality delivered by the insourcer). Therefore, the variables in this cluster in the eCustoms case are more specific:

- Member dependence: extent to which the two customs organisations depend on one another (e.g., responsibilities of one are impossible to fulfil without information from the other).
- Peer2peer link quality: quality of the information exchange between the two partners.

An increase in member dependence and/or link quality causes an increase in political support: increased dependence and link quality represent an investment (sunk cost) that partners want to protect and exploit, which is reflected in matching needs and goals.

4.3. Cluster 3: Operational Potential

Cluster 3, called ‘Operational Potential’, contains the remaining six variables of the model that together describe the extent to which necessary assets and procedures are in place at both partners to support close cooperation.

- Logistics maturity: Countries differ in how advanced logistics (e.g., transport of goods and import and export procedures) are. This variable represents the difference of logistic maturity of two potential partners.
- Architectural knowledge: The difference of architectural knowledge that each country has of its own systems.
- Stakeholder commitment: difference in degree of commitment of the stakeholders of each of the two countries to make the link. The stakeholders are the ones mentioned in Ponisio, van Eck and Riemens (2008), i.e., architects, etc.
- Stakeholder understanding: difference of the extent of stakeholder understanding of the issues of the system in the other country.
- Matching architectures: difference in the extent to which the relevant parts of the IT architecture of each of the two countries is standardised. The potential to match two architectures of the supporting systems of two peer countries (this is at operational level).
- Data transfer safety: difference in the extent to which each of the two trading partners ensures safe data transfer and processing.

All six variables in this cluster are what we call ‘delta variables’: they represent the difference in quantities of the two potential trading partners, not the quantities for either of them. For all six variables, it holds that an increase in any variable of political support causes a decrease in these differences: the extra resources allocated to the co-operation are used to further standardise IT architectures, implement data security mechanisms, make each potential partner more committed, etc. Moreover, a decrease in this difference causes more and better information flow.

4.4. Examples of feedback loops

4.4.1. Dynamics of political support

As can be seen in Figure 2, the model explains the dynamics of co-operation planning in terms of one balancing feedback loop that comprises all variables in the model. In summary, a decrease in the difference of two countries in terms of operational potential (as represented by the six variables in the cluster with that name) causes better information flow between the partners, which causes an increase in political support.
This increase in political support, in turn, decreases the differences between the two countries (additional operational potential), which closes the loop. This process can continue until the delta variables of cluster Operational Potential balance close to zero. Or, if there is an unsolvable mismatch, customs can choose not to co-operate. Making this kind of reasoning early in the planning process is crucial to correct investment decisions because once the co-operation process started and the contracts are signed, it is difficult to leave and to enter the co-operating group.

4.4.2. Example of late join-or-quit feedback loop

As an example of how this feedback loop operates in practice, The Netherlands customs actually did a co-operation with 4 member states on the support and maintenance of NCTS, a software program used to support Transit movements of goods within Europe. Transit movement information systems of individual member states have to comply with the specification of NCTS, but member states are free to choose an implementation. Initially, the Commission provided and supported an implementation of NCTS. About 7 member states (including The Netherlands) used this implementation. In 2007, the Commission announced that they would stop the support of this implementation and member states had to take over.

Having thus, a matching need, namely, to support their NCTS system at reduced cost, five member states (including The Netherlands) started a joint project to select a common supplier for the support and maintenance. One member state decided not to continue with the others. The remaining participants decided to make one Request for Proposal to select one common supplier. This was possible because political support and operational potential of this group of four member states was high: they wanted to save cost and there was little difference in architecture, knowledge of each other, etc. After the contract was granted, the four member states started a joint Change Board to discuss changes and future needs with the supplier (information flow). At the end, they replaced the European Commission as a supplier with a commercial vendor. In the contract, they now have more influence on changes than before. The four co-operating member states now have an interest in continuing their co-operation (matching goals), which closes the feedback loop.

4.4.3. Lessons learnt

The dynamics can be explained in terms of the topic of co-operation, the properties of member states that are interested and that actually participate, and the way participants work together over time.

The feedback loop in this example suggest the importance of matching goals and needs in the area of the topic of co-operation: if there is not enough benefit in the co-operation (because of the member states properties are changing so there is no match anymore in goals, needs, etc.) a member state can decide not to participate. The example tells us that it is easy to step out in the beginning. Stepping out after the contracts have been signed (exit strategy) has contractual implications, as the contract had exit clauses. In our example, one member could exit easily because the contract included a clause to help in that event. One possible explanation is that the member could have experienced a loss of decision power, because the decisions on a member’s system are constrained by the needs of the group. In our example, participating customs had to agree with others. Similar to leaving a co-operation, it is easier to join in the beginning than after the co-operation has been established, as e.g., important decisions have already been made by other members. In the case of the NCTS example, no member state joined the initial group of four after the contract had been granted.

4.5. Results

The results suggest the usefulness of Systems Thinking to plan co-operation in inter-organisational networks. They suggest that Systems Thinking could help decision makers to improve success in finding good partners for closer co-operation, making the search more systematic and serving as a reasoning tool to analyse the underlying mechanisms.

The results were discussed with customs experts. The experts found that our approach has potential to help them explain decisions related to choosing the best partner for co-operation. Moreover, according to the experts, applying Systems Thinking (i.e., our approach) can potentially optimise the process of finding good partners for closer co-operation because it systematises the search; which is beneficial compared to the current ad-hoc analysis of with whom to co-operate. Furthermore, our approach facilitates reasoning about po-
potential consequences of choosing a given partner *early in the process*; which happens to be crucial in eCustoms.

Regarding internal validity, according to the experts, the method led to the right conclusions (though they would have thought of other variables); which means that the internal validity criterion is met. Our example shows how System Thinking helps stakeholders to reason about the situation and explain the rationale behind decisions. In particular, our model (Figure 2) revealed a feedback loop that (we found later) matched an actual example that occurred in eCustoms.

Moreover, applying Systems Thinking to the problem of ‘what should be done first’ in planning co-operation in an inter-organisational network could be generalised to other cases. In fact, the experts could relate to our findings and expressed that our approach helps them in their need to explore new theories that can be used as basis for reasoning, and that foster systematic solutions. Thus, external validity is met.

With respect to existing theory, our results are in-line with existing work in the area of co-operation in inter-organisational networks (Finnegan et al., 2001). Specifically, our results concur with the insights of Finnegan et al.: (a) “Inter-organisational systems are based more on the strategies of individual organisations rather than on a network strategy”, and (b) “Planning is a continuous decision activity shared by business and IT”. Moreover, our method remains consistent with previous work in the area of power relationships in networks (Emerson, 1962). In particular, our approach reveals power dependence relations. For instance, the concrete real-life example we present shows that participants ended having more influence on the changes (to their common system) than before.

In addition to being in-line with existing research, our approach goes a step further than just explanation by providing a holistic solution to a concrete and complex problem.

4.5.1. Future Work

Possible extensions to the model include adding more variables. The literature of eCustoms provides numerous suggestions; see (Netherlands Tax and Customs Administration, 2005) for qualitative and quantitative data supporting reasoning about potential clusters in eCustoms. In this line of reasoning, candidate properties are organisational autonomy, properties of the current IT architecture portfolio and transaction volumes.

Another type of extension is related to our definition of success: our model focuses on operational success in the event of making two customs’ systems co-operate (short term). However, collaboration success is related to the way network participants work together not only in the short-term, but also in the long run. Whether it is possible to extend the model with consideration to explicit evolution is a topic for future research.

In a different line of reasoning, the validation of our approach suggests a new path for future research. Specifically, systems thinking does not provide a systematic way to find the variables of a dynamic model. Textbooks on systems thinking only advise to organise a brainstorming session with subject matter experts. A possible direction for future work is to investigate whether automatic techniques empowered by visualisation prove to be efficacious to discover the variables.

5. CONCLUSION

In this paper, we applied a Systems Thinking approach to study the problem of selecting partners for closer co-operation in e-commerce. We uncovered a feedback loop that explains how an increase in political support for a potential partner (thanks to e.g., matching needs and goals) causes (via the creation of more operational potential) an increase in information flow, which in itself increases political support. The feedback loop can also operate in a downward way: a decrease in operational potential causes (via a decrease in information flow) a decrease in political support, which in turn further decreases operational potential.

The results suggest the usefulness of Systems Thinking to plan co-operation in inter-organisational networks. The mechanism uncovered was confirmed by experts and by a concrete example. The practical implication of uncovering this mechanism is that it enables stakeholders to improve the partner selection process, supporting understanding of the forces and tensions that govern partner selection. The mechanism also explains why it is important to select potential partners for closer co-operation as early as possible, the importance of willingness to participate, and the gain or loss of decision power that joining a network implies.
ACKNOWLEDGMENTS

We gratefully acknowledge the financial support of the Netherlands Organisation for Scientific Research (Dutch Jacquard program) for the project 638.004.609 (QuadRead).

REFERENCES

Checkland, P. (1981), Systems Thinking, Systems Practice, John Wiley & Sons Ltd.
Netherlands Tax and Customs Administration (2005), “Benchmarking customs IT architecture. exploit commonality, manage variability”.

Copyright 2008 IADIS Press. This is a pre-print version.