

# Using $\Psi$ theory and Activity Theory to Management Organization Change

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**Abstract-** *Activity Theory is a framework to understand the totality of human work and its praxis in an organization, since work cannot be understood or analysed outside the context in which it occurs. Thus, when analysing human work, we must take into consideration not only the actions of individuals but also who is involved, what are their motives and goals, which rules apply in the context, what tools are used and the community in a minimum space where the work occurs. We call this minimum space an activity and can be represented in a diagram called Activity Diagram. This theory also helps to understand the causes of every day organization problems, called contradictions in Activity Theory parlance. It appears that there is a lack of current methodologies that address the question of how to resolve the contradictions and how it assists in transforming an organization. This paper proposes a framework of how analysis contradictions within an organization, using Activity Diagram and DEMO.*

**Keywords**— *Activity Theory; Enterprise Ontology; Contradiction resolution; Organizational Change*

## 1. OUTLINE

This paper discusses the use of  $\Psi$  theory and DEMO methodology in managing organization change using Activity Theory contradictions. Activity Theory (Y Engeström 2000) can be treasured to organization modeling because it introduces an concept in the organization, as a social system, i.e. a minimum important framework for individual actions, which must form the basic unit of analysis. It also introduces the concept of contradiction. According to Engeström [8], contradiction are essential elements in the human activity and can be regarded as historically accumulated structural tensions within and between activities that generate problems, failures and conflicts that at the same time become the ability of an activity to develop itself. Contradictions are constant within the activity system, and their perception and resolution is a natural form to improve activities. A new structure of an activity emerges based on the reflection and analysis of the preceding structure due to the fact the previous work of the people in the organization i.e. their actions either conscious or unconscious are not rigid and arises from the contradictions perceived by them. It appears that at present, there is a lack of methodologies that address the management of contradictions [12]. Traditionally several researchers have addressed the issue of contradictions manifestation as an exception, being recognized that organizations have continuously kept on solving them and that sometimes, despite already having handled the exception in the past. Usually the solution is not recorded either due to absence explicit organizational

rules or due to changes in the organizational structure where this information was stored. This leads to a loss of information on how to solve the exception. This facts leads to the expenditure of an added effort in handling the continuous treatment of the same kind of exceptions [2] [15] [16].

Our proposal aims to deal with the aspects of contradiction management using an ontological model of organization developed in DEMO. The solution takes into account the need to strike a balance between a too structured description and a description too vague on how to manage contradictions.

As a practical example of usage of this proposal, it is going to be applied to a case study consisting of the management of contradictions of a company specialized in information security support services.

This article is organized as follows: Section 2 presents the DEMO methodology and the  $\Psi$  theory that supports it, section 3 presents activity theory, section 4 presents the contradictions concept. Section 5 describes the proposed solution. Section 6 presents the application of the case study and finally in Section 7, results are discussed along with conclusions including the future work.

## 2. DEMO AND $\Psi$ THEORY

The DEMO<sup>1</sup> methodology [3] provides a means of dealing with the complexity of the representation of an

<sup>1</sup> Acronym for Design & Engineering Methodology for Organizations.

organization and its dynamics, and it favors the Complexity Theory to the detriment of deterministic models of organizations. DEMO ontological model of an enterprise fulfils explicit quality requirements, referred to as the C4E quality requirements, which are listed as: coherent (i.e. constitutes a whole), consistent (i.e. contains no logical contradictions); complete (i.e. includes all ontologically relevant elements); concise (i.e., is as minimal as possible) and essential (i.e., is independent of realization and implementation). A more detailed description of C4E quality requirements can be find in [3]. DEMO provides an immaterial specification of an organization through an ontological model of organizations, which emphasizes the description of the core business of the organization and is based on stable  $\Psi$  theory.

**Table 1. Performance in Social Interaction Theory, adapted from (Dietz 2006)**

AXIOM	DESCRIPTION
<b>Operation</b>	Actors perform two kinds of acts and facts: production or coordination acts.
<b>Transaction</b>	Defines the relation between acts and facts in a universal standard transaction
<b>Composition</b>	Describes the interrelationships between transactions.
<b>Distinction</b>	Establishes the existence of three human capacities playing a role in the operation of actors: <i>performa</i> , <i>informa</i> and <i>forma</i> .
THEOREM	DESCRIPTION
<b>Organization</b>	Organization of an enterprise is constituted as the layered integration of three homogeneous systems: to produce news things (B-organization), to produce information (I-organization) and to store and retrieve data (D-organization)

The  $\Psi$  theory finds its roots in the scientific fields of the philosophy of language, particularly in the Language Action Perspective (LAP), in Austin's acts of communication and in systemic ontology of Bunge [3]. It recognizes the dynamics, the incompleteness, and the uncertainty of the reality of an organization as well as the multiple connections between the components of this reality. It focuses on the use of language to achieve mutual agreement and understanding between people.

According to the  $\Psi$  theory, through their social interactions, people engage in obligations relating to actions to be taken and agree on the results of these actions [3] [6] [5]. This is done via acts of coordination through language that can be understood as issuing a sentence seen as an action. In this case, the act is called a performative

utterance of contractual act and it creates new facts or actions or parts of an action. By stating the act, the announcer does not describe or even state the performing of an action. He is really performing it. The performative utterances do not describe or verify something, they are not true or false, not only the saying or stating, but are part of the action. In general, this means: When we say something, through a locutionary act, with an intent or effect of changing the world (or act upon the world), we are somehow performing illocutionary and perlocutionary acts that cause the intended change.

The  $\Psi$  theory consists of four axioms and one theorem (e.g. organization theorem). A summary of the axioms of the  $\Psi$  theory is shown in Table 1. A complete overview of the theory and associated methodologies is available in Dietz's book [3] and in a number of articles [6] [4][11][1].

### 3. ACTIVITY THEORY

Activity Theory states that human work is always social, cooperative, collective and takes place within a division of labour [14]. The collective activity is linked to the object (purpose) of the activity and the subjects performing it, of which community members (individually) are not often aware of. The concept of the object of the activity is subsumed in the concept of activity in the sense that there is no activity without an object [14].

An activity produces outcomes and is performed through actions, which are temporary and have a clearly defined beginning and an end.. Individual actions are linked to specific targets or goals that are more or less conscious [14]. Actions are performed through operations. Operations are performed in an automatic, unconscious fashion and are not clearly related to goals. Operations depend on the conditions in which actions are performed.

Engeström departed from the theoretical basis of Activity theory propose that the evolution of the activity occurs through various forms of interaction among organisms and their ecosystem [1] . The author suggests a triangular activity diagrams that includes various components (see Figure 1).

The Triangular Activity Diagram suggests the possibility of multiple relationships within the triangular structure activity; however, the main task is always to understand the entire rather than their separate connections. For Engeström, Activity Theory is an important framework to understand the totality of human work and its praxis since work cannot be understood or analysed outside the context in which it occurs. Thus, when analysing human work, we must take into consideration not only the actions of individuals but also who is involved, what are their motives and goals, which rules apply in the context, what tools are used and the community where the activity occurs.

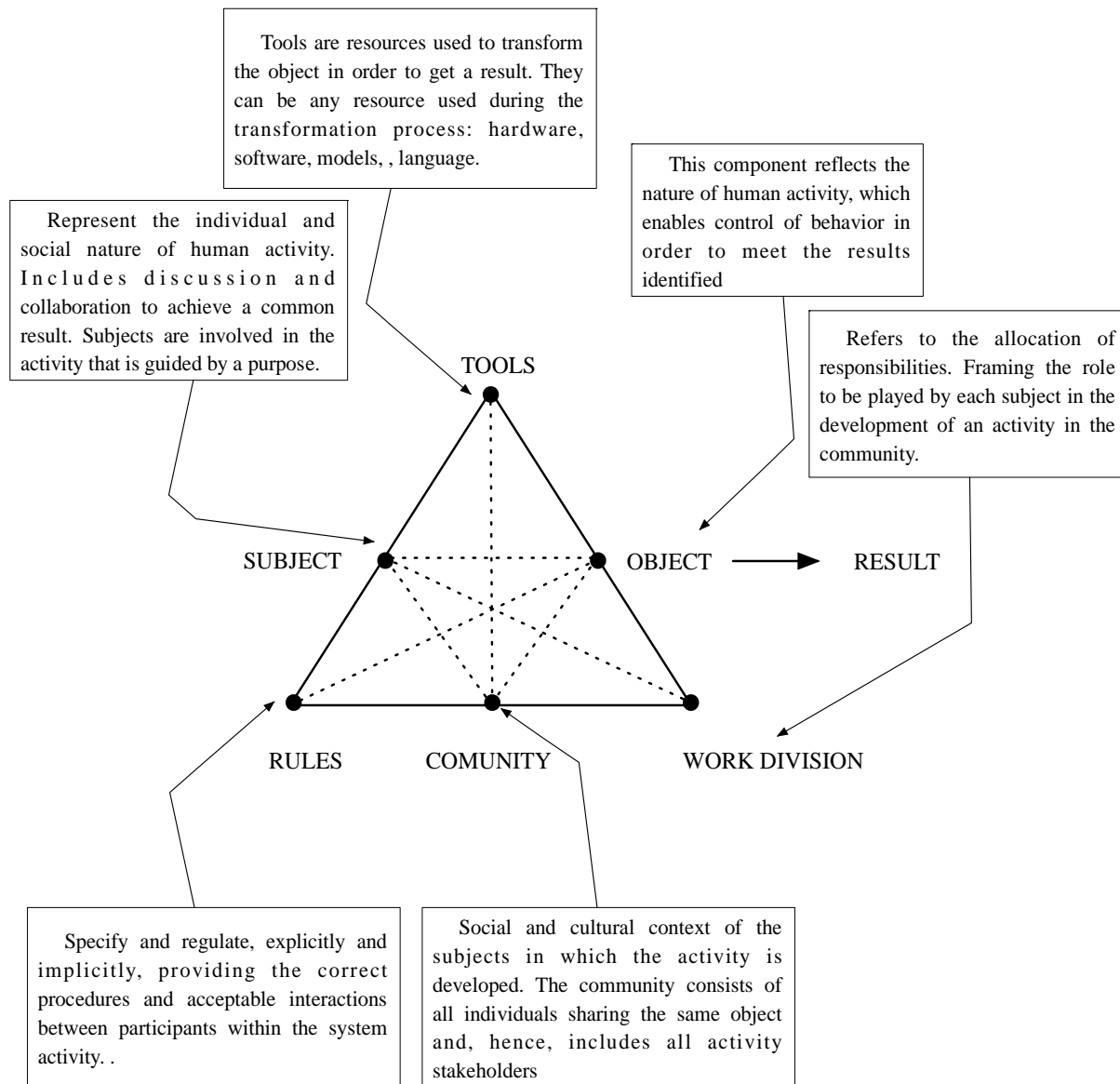


Figure 1. Engeström triangular activity diagram [8]

#### 4. ACTIVITY CONTRADICTIONS

Activity contradictions should be provided as tensions or imbalances manifested by failures, problems or errors, which can be detected by analysing the people work and speech in an organization [10], expressed in the actions and operations performed by a person under an activity [8].

Contradictions can be analysed from the elements that constitute the triangular activity diagram [1][19]. It can be typified as being of the first, second, third and fourth type (see Figure 2.).

The first order contradictions correspond to tensions found in an internal element of a given activity (indicated with circle with the number 1 on Figure 2). It occurs when you can isolate the manifestation of the occurred contradiction, diagnosing that it is due to a particular element of the Activity. The second order contradictions occur because the problem cannot be isolated and are related to the interaction between two or more elements of the activity. They are between the corners of the triangle and occur between the components of the activity system (indicated by the circles with the number 2 in Figure 2).

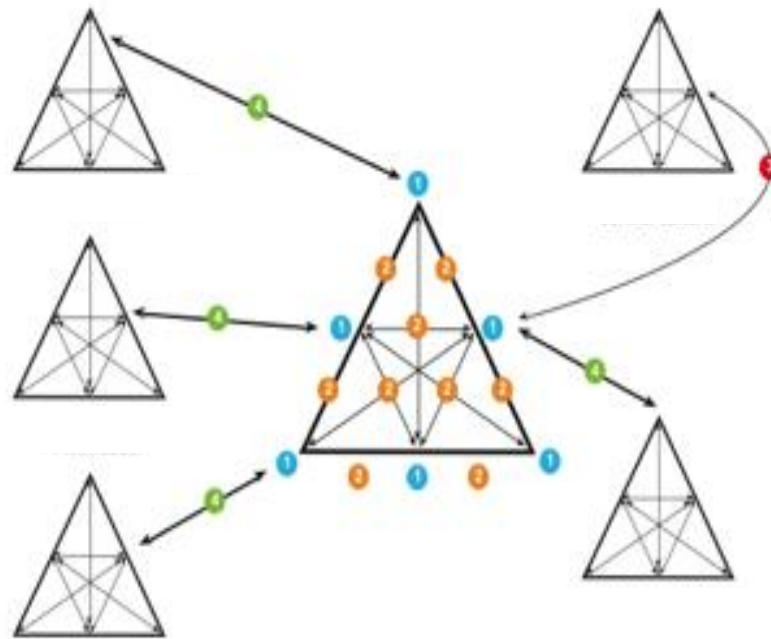


Figure 2. Activity Contractions [8]

The third order contradictions occur when representatives of a culture introduce the subject and motive of another activity system, which is more culturally advanced in the current activity system (indicated with circles with the number 3 in Figure 2). The manifestation of such contradictions arises when conflicts can limit the development of the current activity in relation to a hypothetical activity, which is culturally more developed. Finally, the fourth order contradictions occur between the central activity system and the surrounding activity systems on the systems network and emerge from interaction of the central activity with peripheral activities (indicated with circles with the number 4 in Figure 2). Most of the tensions occur in this situation, where usually a given activity is dependent on a result constructed by another.

## 5. SUGGESTED SOLUTION

Our starting points is the detection of the manifestations of the contradictions and their resolutions in several levels: from small adjustments, changes to the DEMO model, or finally, when necessary, introduce or delete DEMO

transactions. The proposed solution has the following phases<sup>2</sup>:

1. **Actions Diagnosis:** A) empirical analysis of the current situation through the practices in question; B) to discover causes or exploratory mechanisms through the classification of the type of contradiction: 1st, 2nd, 3rd or 4th order;
2. **Recovery Actions:** C) to assist in the construction of a model of a new idea that explains and offers a solution to the problem, through our interpretation on how to apply the changes to the dynamic model of labour, taking into account the roles of the persons in the organization and the levels of collaborative work;
3. **Actions Monitoring:** D) to proceed with the examination of the new model with the intent to understand its dynamics, potentials and limitations and its impact on the Ontological model and ultimately to assist in E) the implementation of the new solution.

<sup>2</sup> The contradiction treatment cycle was based in the cycle proposed by Mourão. [15]



From the standpoint of the separation between the ontological model, realization and implementation of an organization, we follow the proposal made by Dietz [3] (e.g. theorem of the organization in the  $\Psi$  theory). According to our proposal there is a relationship between an activity system and its realization and implementation. Our position is that the implementation is a result of an engineering process in which the system in use is the ontological model and the object system is the implementation that can be represented by a system of activities. The division of the three organizations entities (B, D and I) is present in the implementation of the activities, actions and operations of the activity model. The process engineering and operation is conducted over time with the mapping of activities, actions and operations according to the following rules: R1) An activity system is a representation of an implementation of the organization; R2) Each Ontological Transaction is mapped on an Activity diagram where the result of the Transaction is the acceptance of the production fact; R3) The Actions constitute the implementation of the B-organization, with the following classification of its goals: Coordination and Production Facts goals; R4) Operations are the implementation of the I-Organization and D-Organization that may vary depending on conditions; R5) The Lifecycle of an Activity, actions organization and consequently the operations that they have subordinated in accordance with the translation standard: request phase (P-phase), the execution phase (phase E) and the result phase (phase-R).

The diagnostic process, Recovery Actions and monitoring Actions are done using the standard Action Model (AM) of the organization in question because according to Dietz [3] the AM model is more detailed and comprehensive, it specifies the rules of action which serve as guidelines for the actors to deal with their agendas. It consists of one or more rules for each type of event that represents an item on the agenda of the persons. Action rules specified in the AM act as guidelines for an actor to handle each scenario that will have to act upon, hence these rules are grouped according to the identified roles of the actor. In the AM, all the axioms of the  $\Psi$  theory are related through acts of coordination (application, commitment, affirmation and acceptance, etc.) of each of the transactions of the ontological model and all facts needed for the implementation of acts, whether original or derived that are recovered from the banks of events inside and outside the organization's boundaries.

Table 2 describes the various recovery actions for treating manifestations of contradictions with the ontological model described as an aid in recovery as well as its impact on the ontological model of the organization. After the diagnosis three aspects are proposed in that an organization can find itself in solving contradictions.

Table 2. Recovery Actions

LEVEL	IMPACT ON THE ONTOLOGICAL MODEL
<b>Construction: Orchestration of Transactions</b>	
<b>Expansive:</b> learn and understand	New orchestration of the ontological model links between steps of different transactions and add new transactions;
<b>Reflection: on The object of work:</b>	
<b>Adaptive</b>	
<b>Active:</b> seeks mutual adjustment	To make more explicit the sharing of coordination or production of acts to actors outside the organization;
<b>Reflection: On The Means Of Work:</b>	
<b>Communicative</b>	
<b>Passive:</b> performs tasks, repetitive work.	The Script that defines people's work is the implementation of the ontological model of the organization;

**Communicative / Coordinated Mode.** In the state designated by communicative or coordinated people do their job, defined according to scripts embedded in the actions they plan, in the operations they perform, in the business rules (as described in the model AM), in its division of work (e.g. people who play different roles of actors who initiate and execute the steps of an ontological transaction) and in the community participating in an activity (e.g. group of people involved directly or indirectly in obtaining the result of the transaction). In this operating mode people perform their actions in order to meet their defined targets (make a request, accept it, run it, delivers it, accept it), often without knowing the final goal of the activity / transaction. When there are manifestations of contradictions, such as there may be in a coordinated mode attempts to solve the manifestation, without modifying the scripts, but looking towards to alter the means by which the scripts are run through the articulation of existing resources in the implementation of the organization, especially through technology (e.g. tools and / or persons) including: changing the procedures associated with the operations. However there are situations, for example in the presence of a double blind manifestation in which on an isolated manner people do not reach a solution. This is the case in which people have to cooperate in solving the problem by moving onto a mode of operation called adaptive or cooperation mode.

**Adaptive / Cooperative Mode.** In this mode the manner and type of information that people need to support their actions is questioned (e.g. their operations). At this level, to address the manifestations of contradictions, there is now an awareness of the shared objective of the activity, i.e. the result of the transaction on which people act in a

conscious manner, that guides the decisions making process on the addressed decisions (rules R1 and R2). Depending on the stage at which expression of contradiction is manifested – i.e. phases O, E, R (rule R5) - Several solutions can be implemented. Some of them have impact on the ontological model. The condition associated with a business rule is questioned, which may lead to a modification of the condition of the rules of the AM model. If the contradiction is manifested in the withdrawal of a request by a person or refusal to accept the product (e.g. the actors who play the role of who initiates the transaction), the solution varies in case a person being an employee of the organization or a client (e.g. an actor who is outside the organization or within the organization). In the case of an actor who is within the organization, the proposed solution is that the same person / group plays the role of who makes the request and receives the product or improve access to information (change operations - rules R3 and R4). In case of a customer, the solution is to turn the facts more explicit once created, for the one who is responsible for ordering or receiving the product because who accepts can be a person other than the persons making the request and the organization has no way to enforce that they are the same, to the client. The same solutions are proposed in the cases of those who accept the request or send the product, i.e., the proposal will be to change the structure of the labour division in the implementation of the organization or to change the tools that allow access to shared information. The result is thus the change of the implementation of the ontological model, new subjects are introduced, new rules are established and new tools are introduced and new labour divisions. Once stabilized, the new structure the organization restarts to operate in a coordinated manner. However, even when changing the implementation of the organization, it is not always possible to solve the manifestation of the contradiction, for example it can happen due to critic conflicts, caused by contradictions of 1st order, in this case there is a passage to the mode designated by reflective or construction mode in which the object of the activity (i.e., transaction) can be questioned, this causes changes on the ontological model.

**Reflective / Construction Mode.** In the previous operating modes the work is done keeping in mind the goal that it is fully stabilized. In the construction mode this is not the case. The way people perform their actions is reflective, their own goals are questioned, as the result of weighting the results achieved in the activity. This reflection is the consequence of the manifestation of contradictions characterized as being of a double bond or by a change in the focus of the organization. The result of this reflection will be to stabilize, restore new goals, and then to construct new orchestrations of the ontological model (e.g. bonds between coordination states of the

model) or even the introduction of new transactions, with the consequent reshaping of implementation of the organization (e.g. new labour division, new rules, change to the community). The focus in this mode is to change the ontological model. This mode of operation is uncommon because normally people don't call into question the mission and values of the organization.

## 6. CASE STUDY

KEEP-IT-SECURE-24 is a service provided by INTEGRITY (<http://www.integrity.pt>), which is an ISO 27001certified organization, specialized on Information Security, Telecom Management and IT Governance. It consists of a set of experts and senior professionals in their fields who combine a high level of experience in their industry sectors with relevant international certifications in each of the areas, namely: ITILv3, ISO 27001 Lead Auditor, CISA and CISSP, among others.

KEEP-IT-24-SECURE is available to companies in order to audit, manage and reduce the risk and potential impact that threats to information and technology represent to the business of its customers. Within the service provided, the technological infrastructures and respective applications are audited to timely identify and correct any vulnerability in the infrastructure of customers that may pose risk to the confidentiality, integrity or availability of information. The service is composed of a platform, which facilitates communication between INTEGRITY and organization where the security tests are performed. This service emerged to eliminate the shortcomings of current systems, through the definition and the introduction of a completely new and radical concept, with respect to existing solutions in the market that adds a communication platform with the customer that supports change on the client on a continuous mode. Figure 3 shows DEMO model of the service.

Through analysis of the manifestations of contradictions from the activity model it is possible to analyse the analytical states: Communicative / Coordinated, Adaptive / Cooperative and Constructive / Reflective.

In the coordinated state the work is performed as celebrated once made the contract with the clients. The safety tests follow the procedure and the necessary resources are assured in order to perform the laid down tests in time and depth. People perform actions and operations according to established business rules, there is a clear division of labour: vulnerability communication, acceptance, resolution and verification. Associated with this division, there is a whole set of people who are part in the community activity. When you are working on a coordinated mode people perform their actions to achieve the goals previously set.

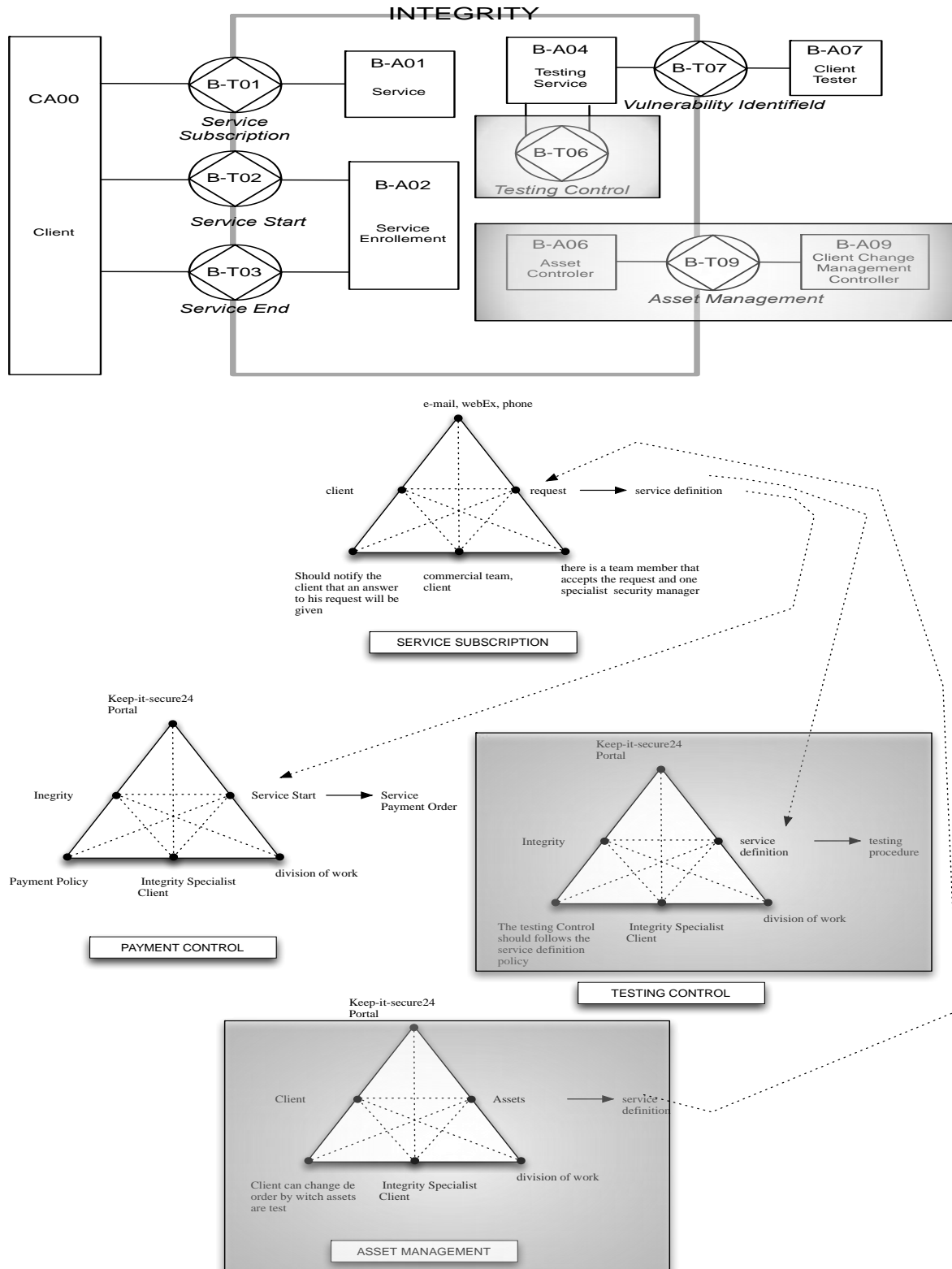


Figure 3. KEEP-IT-SECURE demo and Activity models



However over time, during the execution of the safety tests, either because new types of vulnerabilities appear, which have to be analysed, or because changes are made in the infrastructure of the client resulting in the change of the client's service context, manifestations of tensions emerge which lead to blockage. This blockage is manifested by deadlocks in which the client does not recognize vulnerabilities as such, or because the testing team does not recognize that these have been solved, or finally because there is no agreement on the new testing coverage. For this reason people start working in a cooperative mode, between the test team and the client in order to solve the problems. This results in new actions, new rules and a new labour organizations division. New features are introduced on the tools that assist the execution of the work. As an example of situations that resulted in the appearance of such manifestations of contradictions we can highlight the change on the resources required to implement the test through a new agreement of test coverage.

Nevertheless and regardless of the verification that in cooperative mode this is possible to address the manifestations of the contradictions, it turns out that there are situations where this is not possible. We identified two situations: the first was the inability to follow, in an effective way, the change of focus in the infrastructure testing, due to changes made in the client's infrastructure and the other consisted in keeping the tests on the scope and duration agreed. To solve this it was necessary to move to the expansive or construction mode, materialized by the introduction of two new transactions: The first, known as Asset Management (B-T09) and the second called Test Control (B-T06). The transaction assets management is intended to enable the customer to define their test priorities on relation to its assets. The customer is able to inform, at each moment the test team, of which changes should be made on the tests performed, by a shift in focus. If the client does not inform the team, then it will be the responsibility of the testing team to establish the test execution plan. Test management aims to keep the time and scope of the tests that should be performed according to the plan set with the client.

The Control Test Transaction (see figure 3) is aimed at the periodical analysis of the performance of the work developed between the test team and the client and to detect deadlock situations or loss of efficiency in the detection of gaps in the client. The control tests, every time it senses inefficiency on the tests, conducts innovative procedures in order to try to find new areas of action in order to continue to provide quality customer service.

## 7. DISCUSSION AND CONCLUSION

This article discussed how to treat the manifestations of contradictions present when analysing organizations, through modelling the deployment using activity diagrams,

obtained from ontological transactions. Activity diagrams are obtained from the Ontological model, developed in DEMO, by applying a set of transformation rules of ontological transactions in Engeström Activity diagrams. The analysis was done on the organization through the manifestations of contradictions, analysing the dynamics of the organization in three phases. In the coordination phase people perform their tasks and subordinated actions in isolation, but contributing to the achievement of the results of each activity. The manifestation of contradictions are handled through the awareness of the conditions that lead people to perform operations in accordance with the existing conditions at each given moment. We believe that in this phase the script that defines people's work is the implementation of the organization.

In cooperation phase, the goal of the action is consciously shared, by which people seek to make changes to the implementation of the organization in the form of amendments to the rules and the distribution of work, on the choice of tools in order to reach the satisfactory level of cooperation, to solve the manifestation of contradictions. Once achieved, the organization moves back on operating in a coordinated manner. We've identify some of the actions that are performed in this mode: Change the condition of a rule in the AM model; to make clearer the sharing of coordination production facts to actors outside the organization and to propose that the actor making the request and that accepts the product is the same or that he shares information about facts. The same applies to the actors that accept the request or delivers the product.

Sometimes, it is not possible solve the manifestations of contradictions, or then these are recurrent. Under such conditions people move to a stage called reflexive or construction phase where the very purpose of the activity is questioned. At this stage, we believe, that there may be changes to the ontological model or changes in how the process steps are orchestrated, i.e. new connections are made between different transaction steps and new transactions are added. Once established the new goals, it is necessary to materialize these changes on the implementation (through rules, tools, labour division, community building), so that the organization can then return to operate in a coordinated manner. As a conclusion, we can state that the treatment of manifestations of contradictions provides a basis to understand how the ontological model changes over time.

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