

Theoretical Support for Community Informatics Applications

José A. M. Cordeiro and Joaquim Filipe

Department of Systems and Informatics
School of Technology of Setubal,
Polytechnic Institute of Setubal,
Setubal, Portugal
(j.cordeiro@computer.org, jfilipe@est.ips.pt)

Abstract

This paper contributes to the development of a theory of Community Informatics by proposing a theoretical framework for the development of information systems for supporting community activities. Often, community informatics applications are ad-hoc systems, without adequate theoretical support. In our research we have studied and developed an approach that is theoretically sound and can be used for the analysis and design of information systems that support coordination of community activities using information technology. The emphasis of this novel approach is on people rather than on technology.

1 Introduction

Information Systems are often seen as the backbone of much of the western world activity. We go further and claim that information systems exist even without technology: any organization is an information system itself, therefore the importance of understanding organized activity goes beyond technology applications. Technology, however, can be quite useful for supporting and even automating many organisational activities, especially those that can be formally defined.

The focus of this paper is in the support of organized activity rather than its automation.

A high proportion of computer systems fail; some researchers estimate software failure rate around 40-50% (Stamper, 2000). The main problems are connected with system requirements rather than with technical aspects. This has led many researchers to consider human and social factors regarding information systems and to base technical solutions on theories that account for these factors. Following this social approach to information systems development, this paper introduces the Theory of Organized Activity (Holt, 1997) and shows how this theory can be used in information systems development for the coordination of community activities.

In the Theory of Organized Activity the main element is the human action. The computer is seen as a tool for supporting individual and organizational activities. The emphasis is put on how to increase people communication and coordination capabilities, using computers.

In section 2 we introduce the main concepts and axioms of the Theory of Organized Activity, as proposed by Holt. In section 3 we include a critical analysis and suggest some improvements on the Theory. In section 4 we propose this Theory as the basis for virtual community modelling and, finally, in section 5 we present the conclusions of our research work and delineate some guidelines for future work.

2 The Theory of Organized Activity

2.1 Introduction

“Like language, organized activity exists wherever and whenever people exist” (Holt 1997, p.1). This simple statement provides a new way of looking at all kinds of human organization(s) and is the basis for the Theory of Organized Activity (TOA)

TOA through its particular view toward human activities establishes a systematic way of analyzing the structure and the (human) processes which are behind all organized activities. From its perspective, computers and information systems are seen as a supporting tool for human activities.

From a theoretical point of view, TOA is based on a general **theory** about organized activity, which is independent from technological support, and from a practical point of view it shows a **vision** of its application using computers:

Next section will reproduce and describe some of the main theoretical concepts of TOA that are fundamental and structuring. The section after it will present the practical view of TOA application using computer support – the *vision*.

2.2 Theory – Units, Actions, Bodies, Persons, Organizational Entities

Before we can use TOA we will need to understand the technical terms in which it is expressed. Last statement looks obvious, however it carries a deeper thought: There is a community which understands (and maintains) a group of terms with a particular meaning which allows them to communicate inside their activity. In this case the activity is the work with the theory itself. The presence of *terms* with a particular signification is a common characteristic of all organized activities. Take, for example, the term ‘inheritance’ it has a different meaning to the programming community from which it has for people in general. According to this perspective, TOA will be introduced through the UNITS¹ by which it is expressed. UNITS acts like the technical terms used in a theory and which are understood by the associated community. Statements 1 to 11 are transcribed from (Holt, 1997).

1. Every social group (or community) bound together by organized activities has its UNITS.
2. Associated with every UNIT of a community is a CRITERION which this community maintains – a CRITERION by which its members decide whether a given something is, or is not, a REALIZATION of the UNIT.

In TOA definitions and axioms are avoided, instead a CRITERION is used. The target is to transmit the CRITERIA for each UNIT without using definitions, and to formalize the theory through *basis statements* as the ones showed in 1 and 2. This choice allows applying CRITERIA that doesn’t need to be expressed in word and/or symbols. So, 1 and 2 are the first two basis statements that explain the basic expression mechanisms of TOA.

3. An ACTION is the UNIT of (human) effort.

¹ As in the book where the theory was first introduced, in this section it was chosen to use caps to distinguish the terms used as technical terms (units) from the same terms used currently.

In TOA we are particularly interested on human act or ACTIONS as part of all organized activities. Statement 3 introduces the (human) ACTION. It should be noted that *all* actions are necessarily units of human effort.

4. Every ACTION is doubly performed – ORGANIZATIONALLY and PERSONALLY. Correspondingly, there are two types of ACTION PERFORMERS: ORGANIZATIONAL ENTITIES, and PERSONS.

5. A PERSON assumes a RESPONSIBILITY by becoming an ACTOR, (...) who plays a role in an ORGANIZATIONAL ENTITY.

Statements 4 and 5 present the ACTION PERFORMERS, which are *always* PERSONS. An ORGANIZATIONAL ENTITY can be understood as a role performed by one or more persons within an organization. As an example, a President of a department is an ORGANIZATIONAL ENTITY. Following this example and from 4, an ACTION performed by the President it is also performed by the person that plays that role.

6. ACTIONS are driven by the INTERESTS of their PERFORMERS. PERSONS have PERSONAL INTERESTS; ORGANIZATIONAL ENTITIES have ORGANIZATIONAL INTERESTS.

7. To make an organized activity efficient and effective requires bringing all INTERESTS involved – PERSONAL as well as ORGANIZATIONAL – into proper alignment with one another, in every imaginable combination.

Statement 6 introduces INTERESTS which are the drivers of ACTIONS and, from 7 it is possible to notice its importance in order to achieve activity success. RESPONSIBILITY is another important issue in TOA that is part of all ACTIONS and it's assumed by the ACTION PERFORMERS. Machines do not perform ACTIONS because, according to TOA, neither responsibility nor interest can be attributed to a machine.

8. BODIES are material UNITS

In an activity, besides actions also materials should be considered. In TOA a BODY represents a physical thing.

9. Every ACTION INVOLVES at least one BODY; every BODY is ENVOLVED in at least one ACTION.

10. BODIES extend in space; ACTIONS extend in time.

11. The BODIES which an ACTION INVOLVES are, together, called the THEATER of the ACTION; the ACTIONS which INVOLVE a particular BODY are, together, called the LIFE of the BODY.

Statements 9, 10 and, 11 establish the relations between action and bodies. They also define the spatial and temporal dimensions of any activity by relating time with actions and space with materials.

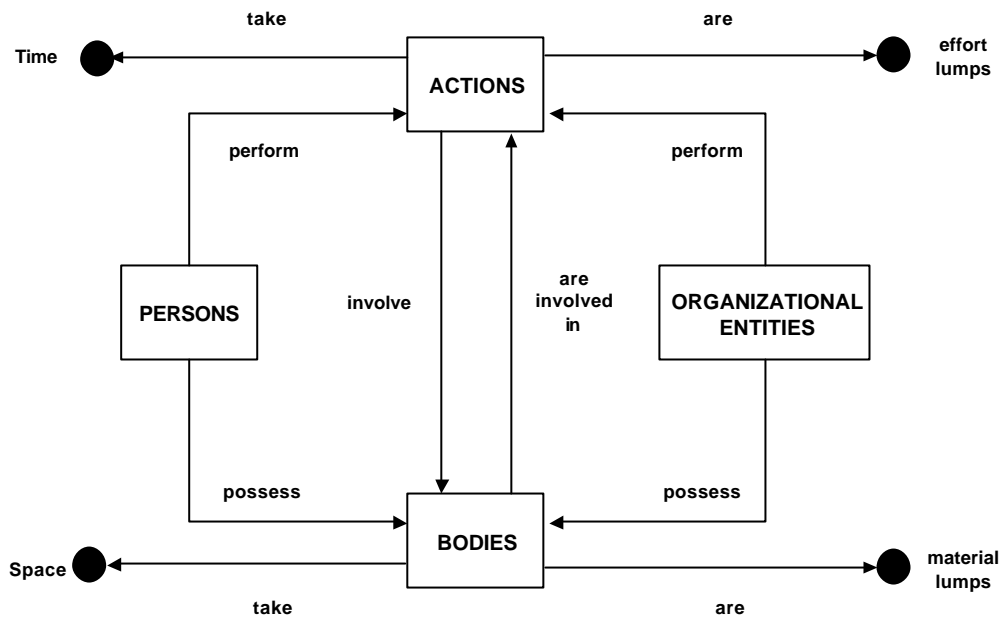


Figure 1 – Theory of Organized Activity Kernel

All mentioned concepts are summarized in figure 1. This figure defines the TOA kernel which relies in two dichotomies: PERSONS/ORGANIZATIONAL ENTITIES and ACTIONS/BODIES. The grand hypothesis is that: “all organized activities, no matter how complex and subtle, can be *usefully* represented in this terms...” (Holt 1997, p.56).

TOA also defines a graphical language – *DIPLAN* language – to express action plans. An example of a DIPLAN graphic is presented in figure 2.

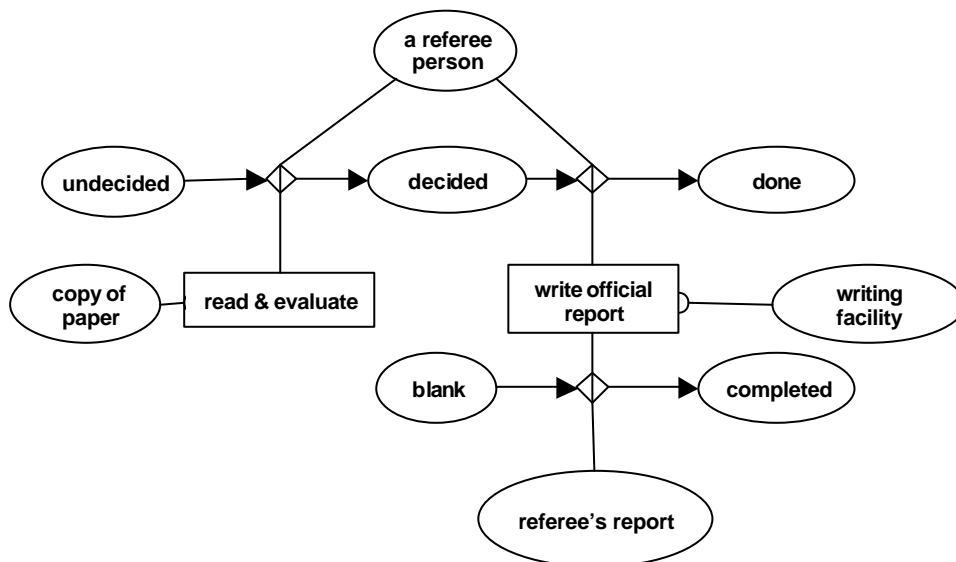


Figure 2 – DIPLAN graphic of a scientific paper revision process

2.3 Vision – Pulsar and Igo

The **vision** in TOA presents a possible view of its application regarding the computer support to human activities. There are two main applications in the vision:

Pulsar and *Igo*. These applications are related respectively with the coordination of groups and the coordination of individuals.

PULSAR

Pulsar can be seen as a software package which aim is to coordinate the interaction among a group of people (or community) engaged in an organized activity. When we look to a communication between two persons we can observe a *pattern of interaction* where both intervenient express alternately. If we add more people to the conversation, as in a meeting, other pattern(s) emerges. *Pulsar* defines one of those patterns, acting as an *Electronic Meeting System* with a *manager* and N *contributors*. *Pulsar* interaction process evolves in two steps: 1 – the *manager* prepares and broadcasts a *stimulus* to each of the *contributors*. 2 – Each of the *contributors* produces and returns a *response* to the *stimulus*. From all responses received the manager prepares a new *stimulus* and the process is repeated until the objectives are fulfilled. It is also possible to parameterize the *Pulsar*. For example the exact time of the *stimulus* broadcast can be preset, can be adjustable or can be made dependent from the received responses.

Some *extras* can be added to improve the system, namely:

1. an auxiliary communication tool – an electronic message system, where the address of all messages will include the *organizational entity* and may include the name of the communicating *person*
2. a *stimulus* specialization – where different stimulus can be sent dependent on the addressed contributor
3. a *result-to-date* repository of data – to which all members have access and where it is stored the common data.

Examples of application of this package could be *electronic meetings*, document production, special interest groups, auctions, etc. Some of these applications and the advantages of this system are analyzed in detail in the book which supports the theory (Holt, 1997).

IGO

Igo is a different software system oriented towards computer support of individual activities. *Igo* makes it possible to manage and to coordinate each ones work. Its emphasis is in what the user see, does and experiences with the system.

For each activity where someone is involved there is a *center*. This *center* groups and maintains all the information and all the coordination aspects related to the activity. As an example a *center* could look like a directory from a common operating system, having a hierarchical structure and presented as a folder. However, this *center* is more than simply a group of files and folders. In a *center* we can also find:

1. Current status information (CSI) – where is information about the *state* of the activity: how much time was spent, what needs to be done, time to expend, time left to a particular work, etc. This information is updated whenever some effort is spent on the activity.
2. Mail to and from the centers – this is a messaging system, as in *Pulsar*'s auxiliary communication, with a mailbox per center. Messages addresses include the originating center, and the organizational entity. Note that incoming messages change the state (CSI) of the *center*.
3. Current managerial information (CMI) – where is optional information that would permit to control the activity. This information would be accessible from higher hierarchical *centers*.

Just as an example, we could define a *center* that would represent the activity of producing a report. It would be possible to establish the time to spend on its production, the schedule of the work, and keep this information in the CSI register. When some time was spent on this report, the CSI would be updated. Information about time spent, time available, scheduling, etc, would always be available from the CSI. If there were different activities it would be possible to know if there is time available for new commitments. Information about the progress of the report will be kept in the CMI.

Another important feature about *centers* is the possibility of transferring them. If it is necessary to change a person from an activity it would be possible to move the *center* to the new person.

With *Igo* computer would have to change the way it relates to people. This change could affect also the operating system, especially the user interface. We would see *centers* instead of folders and this visualization would help people to conduct their organized life. A message arrived to a determined center, an urgent work to be done or some other event would be reflected in the visualization of the center. This could be achieved with a different coloring, a blinking, an added text, or any other interface element which would be used to call the attention of the user. This idea goes with an effective support to human activities.

3 TOA in Information Systems Development

The Theory of Organized Activity proposes a new way to look to Information Systems, based on human activities. The interest of this approach is confirmed by observing that human and social issues in Information Systems Development have been receiving increased attention from the Information Technology community, including the object-oriented community and in particular researchers concerned with UML standards (Parunak and Odell, 2002).

To build an Information System from activity analysis seems to be a promising approach, following the current tendency of business process modeling driving information system design (BPMI, 2002).

We propose here a new approach to Information Systems design based on main ideas from TOA. The theoretical model defined by TOA applies to activities in general, and could be useful in the planning and management of “community activities”. In this context, practical applications of TOA, such as those exemplified by the vision, Pulsar and Igo, could serve as well as the applications of communities’ informatics.

First, a distinction between activities in general and organized activities should be drawn. We could say that humans had always been involved in activities, individually and socially. Organized activities emerge from activities as a management necessity. Before computers, the organization of an activity was mainly the definition, coordination and execution of actions by the members of an organization. As material support to those activities there were produced documents with rules, contracts, business data, etc. Computer brought new possibilities to the support of activities. However, we should emphasize that not all activities need organization, and even those that need it some of them doesn’t need computer support. It would be necessary to take into account all costs and benefits involved in a computer solution.

Our proposal is to use the activity concept as a structural element that bounds together people, actions and materials and form the basis of any information system supported or not by computers. In this view the group of people involved in a common

activity forms what we can call a community. From this perspective each activity will define and have a special context or ontology. Inside each activity community members will communicate using its own terms, or UNITS as defined in TOA. The members of the activity will have the responsibility and the maintenance of the defined context. Any changes of its members will have effects in this context. It should be stated that *meaning* depends on context. As an example, units on which activities depend, have an associated criterion according to TOA which is maintained by the community, they are a social construction. If we change a member, the associated criterion of a unit, can achieve a different (common) understanding, changing the unit original meaning because there was a change in the context.

An activity as a structural element can be found in practice. For example, an enterprise is an activity where we can find people working in a particular environment. Also, a department, a commission, or even a simple report production can be understood as an activity. Their common characteristic is that it joins actions, materials and, people (as individuals and as organizational entities). From this perspective each activity will represent an Organizational Entity.

In the practical application of TOA, defined by the *vision*, we have two main elements: *Igo* for individual coordination and *Pulsar* for collective coordination. These elements will represent the main instruments for coordination of communities. Actual software applications seem to ignore what it should be its main goal: to support human realization of tasks. In this sense, they omit communication, coordination and cooperation capabilities to their users.

Pulsar establishes a communication pattern between human that could be used as a coordination element of an activity. Communication, in all its forms, is the link that bounds people together. Its importance is fundamental on performing an activity. So, to find out and to define new patterns of communication, and/or interaction could bring useful solutions to the activity success. It will be easy to imagine and to create new interaction patterns besides *Pulsar*. As an example we can have a round communication pattern where each member of a group sequentially will have the opportunity to express himself.

4 TOA as the Basis for Virtual Community Modeling

TOA is a general theory for the analysis and design of information systems based on activities. It follows a social-technical approach to information systems development assuming social constructivism as its philosophical stance. According to these ideas communities arise naturally from each activity, or, by the other hand communities exist because they are involved in some common activity. In this sense TOA is a natural candidate for use as a theory for supporting social group activities. Virtual (and some local) communities are based on computer information systems to subsist. With TOA we can design and plan the community activities, and have the necessary computer support. As explained before TOA shows in its *vision* examples of practical applications to support the activities, namely *Pulsar* and *Igo*. However, we can have other applications that could import some of the important characteristics. A popular web application that has some of the characteristics of *Pulsar* and *Igo*, and it is used by many (virtual) communities is the Yahoo groups (Yahoo Groups, 2002). What we claim is that Yahoo groups can be seen as an example of an application that implements the concept of a TOA *center*. As a *center*, a Yahoo group is like an activity, where people, actions (messages, management procedures, etc) and *bodies* (files) are bound together. In this sense to create a Yahoo group, is just as create an activity *center*. But there are other similarities:

- Messages carry the Yahoo group identification as messages to and from the *center* do.
- Information about people and performed actions (messages sent, members management, etc.) functions as CMI information of a center.

In a first analysis the expansion and adaptation of a Yahoo group can lead to an effective implementation of the ideas presented by TOA. This can be achieved by incorporating a few more concepts. This is the case of some ideas presented by *Pulsar* and *Igo* that could be used. From *Pulsar* we can import the coordination obtained from the implementation of the interaction patterns of communication. From *Igo* besides some of the analogies with Yahoo groups there are some guidelines that should be followed in order to adapt Yahoo groups to TOA. One of the most important ones is the interaction between the computer and people. From the general ideas provided in *Igo* we can derive that to effectively support human activities the computer shouldn't be a passive part. As an example a *folder* in *Igo* should reflect the *state* of the activity, and could warn the user for some work to be done in one of his activities, for some mail that arrived, or for any other relevant event. The important point is the interaction between the user and the computer in the direction computer to user. It should be noted that these interactions could be done using an interface element or any other computer output device.

5 Conclusion

TOA proposes a social approach to the design and use of Information Systems. In this context human action is the key-supporting element. TOA provides a sound framework for the specification of virtual communities' shared knowledge and their activities.

We believe that using TOA we can improve information systems flexibility and ease of change. We also claim that this theory provides natural mechanisms for supporting the coordination of individual and organizational activities.

As current research work, we are studying the integration of TOA with the normative approach proposed by organisational semiotics (Stamper, 1996; Stamper, 2000). We are also exploring the development of activity coordination models using the Language/Action Perspective initiated by Winograd and Flores (1986).

The future work includes the application of these ideas to the development of an e-learning system for the School of Technology of Setúbal (e-learning-Setúbal, 2002) Another research area is the development of a new diagrammatic language to support the Theory, that is envisaged as an UML extension for designing activity models of organizational activities and their support by computer.

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