

# EXPERIENCE-BASED SOCIAL AND COLLABORATIVE PERFORMANCE IN AN 'ELECTRONIC VILLAGE' OF LOCAL INTEREST: THE EKONEΣ FRAMEWORK

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**Abstract:** We present the baseline of a framework called eKoNEΣ, for building electronic villages of local interest. An electronic village is considered as a virtual organization formed by representatives of different sectors who work together during a period of time to realize a common goal. We assume tight coupling between the virtual organization and a physical space to differentiate the electronic village of local interest from the notion of the global electronic village. In this context, the paper focuses on two primary issues, namely the stimulation and organization of collaborative work by virtual teams and the design of electronic artefacts which facilitate collaborative feedback and feedthrough in an exemplar case in the context of eKoNEΣ-Tourism – a pilot electronic village on regional tourism.

## 1 INTRODUCTION

In recent years, virtual community fabrics have matured to the extent that allows the establishment of novel virtualities and new concepts, which characterise on-line communities by function and scope rather than technological character. Examples include the virtual classroom, the electronic city, etc. In the majority of these cases, the distinction is drawn around functional rather than technological characteristics. A virtuality, which has recently received substantial attention, is the electronic village of local interest. The electronic village is a virtual organisation tightly linked to a physical space. In the literature there are various examples of electronic villages / cities (e.g., Carroll et al., 2001) acting as catalysts to local community social and economic life.

In the context of on-going collaborative research and development, we are developing technology and tools for building local electronic villages as unified collaborative spaces for managing electronic services of local interest / scale. This definition makes a sharp distinction between an electronic village of local interest and the notion of the 'Global Electronic Village'. The distinction amounts to the fact that the former concept emphasizes a tight

coupling between virtual and local physical activities, while it affords opportunities to develop alternative forms of productive social relations between members.

eKoNEΣ is a collaborative R&D project, which seeks to extend the conventional connotation of an electronic village so as to provide an operational model of a virtual organization with strong social links between members and focus on performing tasks to yield added-value products and services. The project will demonstrate its outcomes in the area of tourism by developing and operating eKoNEΣ-Tourism – a regional electronic village on local tourism – as a pilot. In its basic form eKoNEΣ seeks to facilitate community problem solving by fostering tight collaboration between multi-sector community groups, frequently referred to as coalitions or collaboratives. Such coalitions may be permanent or temporal depending on the set targets. For example, in the tourism sector coalitions may be formed on-demand to facilitate transportation, local accommodation and entertainment of a group of people interested to visit archaeological sites in a region for a specified period of time. The distinctive characteristics of such services are that they represent added-value for all parties concerned including the end user; they are owned by the

coalition for as long as the service is offered; and finally they are dynamically created through the collaboration between members to fulfil a temporal problem (or demand).

In this paper, we present initial findings and work in progress with regards to the organizational model of eKoNEΣ-Tourism and the architectural underpinnings of the virtual organization. To illustrate the concepts we present a working scenario. The next section provides a contextual account of an eKoNEΣ electronic village. Then we focus on design-oriented aspects of the running prototype emphasizing interactive embodiment of eKoNEΣ communities and collaborative work practices. Finally, we draw some conclusions and discuss on-going R&D activities.

## 2 THE VIRTUAL ORGANIZATION

eKoNEΣ in its basic form seeks to provide the fabrics for community problem solving by fostering tight collaboration between multi-sector virtual teams. A multi-sector collaboration is a partnership formed by representatives of at least two sectors (non-profit, private, and public organizations and community members) to solve problems that impact the whole community. It is a form of a virtual organization (Davidow & Malone, 1992) characterized by the fact that its members belong to different organizations, and that they all work together during a period of time to realize a common goal. A virtual organization is defined as a geographically distributed organization whose members are bound by a long or short-term common interest or goal, and who communicate and coordinate their work through information technology and tools (Dustdar & Gall, 2003). Members of virtual organizations assume well-defined roles within the context of the virtual group that are independent of their role in the organization employing them. Recent studies show that with the emergence of information technology, virtual organizations become more and more interesting in today's form of business. Vartiainen discusses dimensions types and characteristics of virtual organizations (Vartiainen et al., 2001). Jarvenpaa did empirical research on trust and communication (Jarvenpaa et al., 1998) and Lethbridge proposed a taxonomy of virtual organisations (Lethbridge et al., 2001).

The design of eKoNEΣ exhibits several novel characteristics, which differentiate an eKoNEΣ-

based electronic village from other forms of on-line communities and virtual organizations. First of all, eKoNEΣ is not only concerned with computer-mediated communication, but instead, it seeks to provide an environment for harnessing knowledge in collaborative settings. Consequently, its primary focus is to enable virtual teams to reach high stabilization and perform tasks. To achieve this, eKoNEΣ builds on a range of technologies, including semantic web technologies, groupware and advanced Human Computer Interaction. Secondly, eKoNEΣ adopts a knowledge-based and reuse-oriented model to attain high quality during the performance of collaborative tasks. This model is stimulated from the notion of software factories (Aaen et al., 1997) and in particular the concept of an experience factory (Basili, et al., 1993) extended to facilitate social and collaborative workflows biased towards information exchange, learning and experience sharing and new product development.

### 2.1 eKoNEΣ as an Experience Factory

From a functional point of view, an eKoNEΣ electronic village operates as an experience factory to facilitate the operation of eKoNEΣ squads. The basic architecture of such an experience factory is depicted in and is adapted from the original formulation of the experience factory (Basili, et al., 1993). Parallels are to be drawn between the software development organization and the experience organization in the original formulation of the experience factory and our notions of an eKoNEΣ squad and eKoNEΣ experience organization respectively. However, the processes being executed by an eKoNEΣ squad are different from those designated in the experience factory. Similarly, the eKoNEΣ experience organization depicts domain-specific functions and workflows as shown in Figure 1.

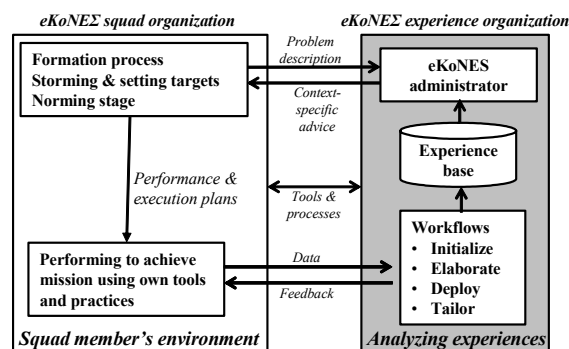


Figure 1: eKoNEΣ as an experience factory.

### 2.1.1 eKoNEΣ Squad Organization

The term squad is used to denote a small group of people acting as a team for a specified period to fulfil a particular mission. Members of an eKoNEΣ-Tourism squad typically come from different sectors (i.e., transport, hotels entertainment, cultural heritage) to provide owned resources towards meeting a set target. Their work is mission-driven and their mission either succeeds or fails, which implies a clear measurability of their tasks. In due time, an eKoNEΣ squad may change in form and structure depending on contextual and circumstantial factors (i.e. a member may be temporarily unavailable or unwilling to commit further resources).

The lifecycle of an eKoNEΣ squad follows typical stages indicated by sociological research into small group activities (Tuckman 1965). A squad is dynamically formed on the grounds of matching mission-specific requirements against members' deposited resources. Dynamic formation does not ensure stabilization and effective performance. Instead, empirical evidence suggests that group stabilization is strongly correlated with the group's ability to effectively move from the initial forming and storming stages into norming and performing. In other words, a group's degree of stabilization becomes higher as the group progressively moves from forming (i.e. trying out activities, expression of opinions), to storming (i.e., resolving conflicts) and into norming (i.e. enfolding group coherence, setting group objectives) and performing (i.e. carrying out activities towards the group's mission).

To reach the performing stage, eKoNEΣ squads are engaged in a variety of computer-mediated interactions. These vary in complexity depending on the group's lifecycle stage. Thus, as the group moves from initial to more advanced stages, the demands upon technological tools increase since the type of exchanges and communication patterns between group members become more complex, targeted and task-oriented to address less well-understood or ill-structured problems (Simon, 1973). During these stages, information flows are more complex, as they typically extend beyond simple message exchanges (i.e., expression of opinion) to encompass constructions and artefacts in a variety of forms, including new models, packaged experience, argumentation, etc.

### 2.1.2 eKoNEΣ Experience Organization

The eKoNEΣ administrator (see Figure 1), which is typically a role undertaken by a human and

augmented by computer-based tools, serves two supporting functions. The first is to act as an experience broker mediating between the virtual assets of an eKoNEΣ electronic village and the active eKoNEΣ squads. In this capacity the eKoNEΣ administrator offers advice on problem solving strategy, tools, and best practices, based on existing experiences. The second function of the eKoNEΣ administrator is acting as a silent critic to mine the data generated by a squad as it works to accomplish its set targets and to codify these data in the form of persistent new knowledge. The tools supporting the eKoNEΣ administrator's work range from simple communications-oriented tools to model building and advanced activity awareness visualization.

The essence of the eKoNEΣ experience is codified in an evolving domain-specific ontology, using Protégé (<http://protege.stanford.edu/>). In the current version of the eKoNEΣ-Tourism ontology, member categories such as residence, transportation, entertainment, cultural heritage, etc., constitute the electronic village's community neighbourhoods. Each category is specialized into sub-classes representing structure of a neighbourhood. Shared resources deposited by members are of two types namely Advertisements and Packages. An advertisement is either an Announcement or a Question posed to the shared message board. A question represents a variety of action-response acts between squad members and is modelled through a single parameterized template. On the other hand, there are various templates for announcements. All templates are instances of the `Template_Layout` class and may comprise resources of various types (e.g., images, text, etc) to facilitate device-specific presentation of announcements or questions depending on the user's context of use. Of particular interest is the eKoNEΣ resource of type `Package` which represents the collaborative outcome of an eKoNEΣ squad. These are resources, which do not pre-exist, but are compiled to serve demand for a new package. The knowledge of types `Package`, `Question`, `Announcement` together with the `Presentation_layout_info` constitutes the primary reusable experiences of the currently operational eKoNEΣ experience factory.

eKoNEΣ packages become persistent following distinct package lifecycle stages (or workflows) as identified in the eKoNEΣ experience organization (see Figure 1). In the package initiation stage, the package subclass hierarchy is extended by creating an instance of an abstract package. At the same time eKoNEΣ-Tourism forms an eKoNEΣ squad comprising all members with registered services contributing to the package. During the package

elaboration stage members of an eKoNEΣ squad seek to populate a designated package with all possible or alternative offerings. The elaboration stage resolves conflicts and collates alternatives into concrete package offering. At the end of this stage the package has been agreed and becomes an active eKoNEΣ resource. Following this, the package is released and published to all registered end users. Package personalization and tailoring is the stage where end users (i.e. customers) are exposed to the package and adapt the package so as to reflect own preferences.

## 2.2 eKoNEΣ Architecture

Figure 2 presents the functional architecture of such a virtual organization, distinguishing between three types of knowledge, namely the shared resources (eKoNEΣ Content) deposited by members (content providers), eKoNEΣ packages (new artefacts and knowledge resulting from collaborative activities) and the eKoNEΣ experience base (the accumulated wisdom for reuse), all modelled through the eKoNEΣ ontology. The workflow layer implements the eKoNEΣ collaboration model which is used to harness new content elements and to deliver them as packages to potential customers.

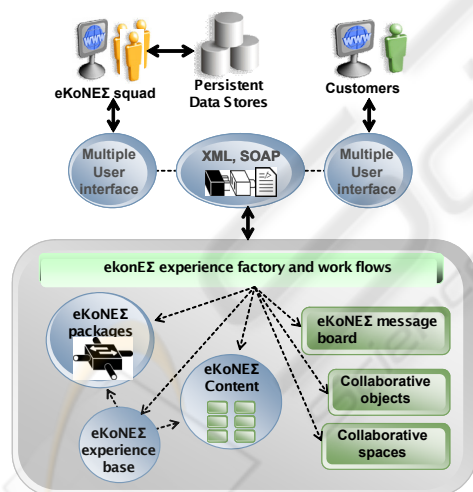


Figure 2: eKoNEΣ electronic village architecture.

## 3 REPRESENTATIVE SCENARIO

To illustrate some of the concepts described thus far and to provide insight into the technical features of eKoNEΣ-Tourism, we will briefly describe a representative scenario emphasizing the collaborative exchanges undertaken by an eKoNEΣ

squad to fulfil an articulated demand by creating a new package. Our reference scenario is summarized in Exhibit 1. Once such a request is registered, eKoNEΣ-Tourism triggers several parallel activities to create an eKoNEΣ resource to fulfil the demand. Some of these activities reuse previously acquired knowledge and available experience while others require eKoNEΣ member to engage in a variety of collaborative exchanges through the eKoNEΣ squad’s collaboratorium (see section 3.2).

### 3.1 Package Development Workflow

The workflows involved in the package development lifecycle aim to facilitate the transformation of an abstract package description into a concrete resource. Depending on the workflow the demands placed upon the squad differ both in terms of communication patterns and content. We will first briefly review these workflows and then describe the squad’s collaboratorium.

Exhibit 1: Fred has just purchased a package for a two-week vacation in a popular resort in Greece. However, as he is interested in history and culture he would like to spend a few days visiting archaeological sites nearby his vacation destination. He comes across the eKoNEΣ-Tourism which allows Fred to specify a request for a new package. Indeed, Fred creates an account with eKoNEΣ and subsequently registers his request. In a few seconds, the system returns back with a message confirming the registration of the request and the initiation of a process to fulfil the request.

#### 3.1.1 Initiation Stage

Once a demand for a new package is posed to the eKoNEΣ-Tourism, a filtering mechanism constructs an abstract package description in XML and assigns to it a collaboration space where members can work to fulfil the package details. Initially, the package is assigned a name, creation date, duration and a list of the domain-specific categories of interest (culture, residence) as defined by the end user when registering his/her interest. Further details are filled-in as the package proceeds from initiation to elaboration and deployment. The second parallel activity, taking place during package initiation is the creation of an eKoNEΣ squad. Squad formation is depicted in Figure 3. The top left-hand side dialogue lists the active packages. Upon selection of a package, the XML-based package description can be used to compile alternative views of a package (see augmented tree-like view on the left and graphic view on the right). At this stage the package is still abstract, while squad formation is in progress.

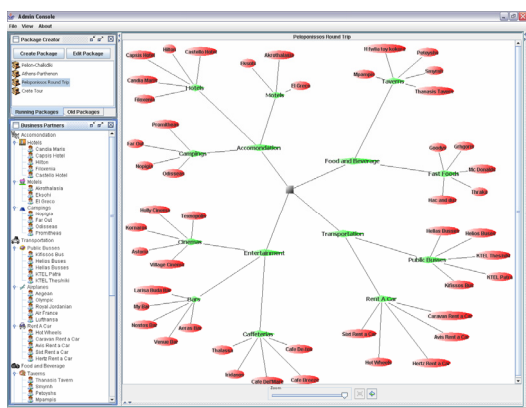


Figure 3: A package in its initiation phase.

### 3.1.2 Elaboration Stage

In the elaboration stage, the objective is to populate a package in terms of specific activities. Figure 4 provides an instance of an interactive package elaboration scenario. As shown for each day of the package, the administrator assigns the activities to take place. These activities may overlap depicting package alternatives to be specified later on or selected by an end user during the stage of tailoring and personalizing the package.

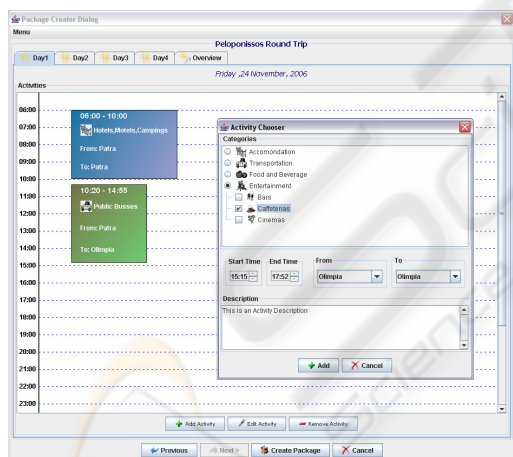


Figure 4: Package elaboration stage.

All activities in a designated day are represented as selectable objects differentiated by colour depending on their type. Activity details can be reviewed and updated as a result of partner messages published in the message board. New activities can also be introduced, thus updating the specific package. At any time during the elaboration phase an overview of the entire package can be obtained.

### 3.1.3 Deployment Stage

In the deployment stage an abstract new package is transformed into a concrete offering with clear illustration of package options and offers per activity. Typical squad contributions during this stage may range from placing bids, making offers, resolving conflicts, to depositing new resources, etc. These exchanges take the form of announcements or questions through the shared message board and result in updates in the package description or declaration of pending issues requiring agreement. Such information is persistent and can be retrieved as in Figure 5.

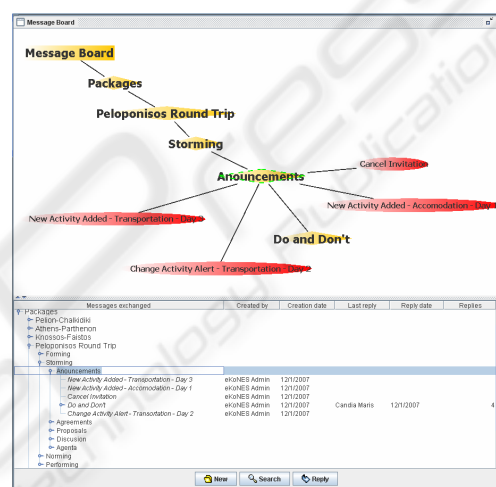


Figure 5: Package deployment phase.

Once the details of the package are agreed and finalized, the package is published as a new resource through the eKoNEΣ portal using a suitable template.

### 3.1.4 Tailoring and Personalizing

In this stage eKoNEΣ-Tourism acts either as an information service, presenting options to the customer and processing further requests s/he may have or as a B2C mediator undertaking transaction-oriented services (e.g., booking, payment clearance, etc). Specifically, once the package is published end users can register their interest in the package. Since the package is fully populated, end users can access it through a variety of devices with clear indication of the tailoring that the user can undertake. The user may request further modifications of the package by submitting requests through the message board and asking the eKoNEΣ administrator and the package squad to consider specific issues. This process may be iterated until a personalized package is created to suit specific user needs and preferences.

### 3.2 eKoNEΣ Squad's Collaboratorium

Having described the package development workflow, we will now briefly examine the social dynamics which characterize distinct phases of an eKoNEΣ squad as it moves from the forming stage to storming, norming and performing (i.e. contributing to the package development). An eKoNEΣ squad once formed meets virtually to accomplish a variety of goals. These goals range depending on the squad's lifecycle stage resulting in different actions on behalf of the squad members. It is very important for administrators to be able to review the squad's achievements and failures per lifecycle stage, thus complementing the package workflow-oriented view presented earlier. For instance Figure 3 depicts the composition of a squad at the package initiation phase. However, this may change in due course as certain partners may have decided to withdraw. For the administrator, it is useful know why this has happened and what implications it may have on the package. To this end, the eKoNEΣ collaboratorium (see Figure 6) and the message board, allow users to trace activities realized across distinct lifecycle stages of the squad.

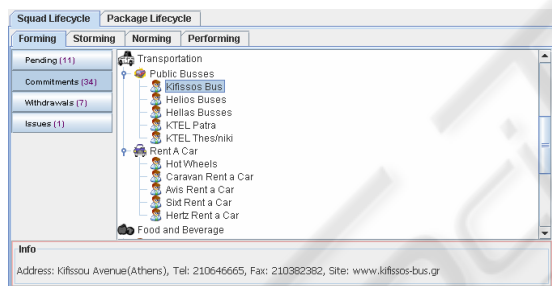


Figure 6: Review of forming stage.

## 4 DISCUSSION & FUTURE WORK

In this paper we have attempted to sketch the organizational underpinnings of eKoNEΣ-Tourism – a pilot effort aiming to build a local electronic village on tourism. Our primary design target is to set up an operational model for carrying out mission-specific social and collaborative activities and to support this model with appropriate software platform and tools. In this effort, we have drawn upon sociological theory describing small group activities to understand the social dynamics in virtual teams and recent models for experience-based and reuse-oriented organizational engineering.

On going work covers a variety of issues of both technological and organizational engineering character. Some of the technological issues to be addressed in the immediate future include scaling up of collaborative exchanges across different platforms (i.e. mapping schemes for platform-specific presentation), improved visualizations for activity awareness, and the development of multiple user interfaces to allow concurrent access and review of shared resources using different devices. On the organizational engineering front, the issues pending attention include operational aspects of eKoNEΣ-Tourism such as extensions in the basic collaboration model to establish on-line quality manuals, mentoring, support for negotiation, etc.

### ACKNOWLEDGEMENTS

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