AN APPROACH FOR EVALUATING WEB-BASED COLLABORATIVE ENVIRONMENTS

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Abstract: The paper presents a study of Web-based Collaborative Environments (CE) with regard to the type and frequency of the embedded tools. A classification is made by the type of tools most frequently included. A model for evaluating and choosing an appropriate environment in a concrete context is proposed.

1. What is a Web-based Collaborative Environment?

Virtual meetings and collaboration occur nowadays more frequently than tradinitional, face-to-face, ones. They are supported by software systems named by the general term *Collaborative Environment (CE).* Usually collaborative environments are embedded in WWW and called Web-based collaborative environments. Such systems may differ significantly in their functional properties. How does a collaborative environment look today? Who uses it? What instruments it includes? How can we choose an appropriate collaborative environment among the great variety of existing CEs? These are few questions we try to answer in this paper. Finally we recommend a model – a stepwise process - that eases the choice of an appropriate CE.

1.1. The purpose of a Collaborative Environment

With the advent of the World-Wide Web many distributed applications have been adapted to the web environment. They are accessible through web browsers by using of http protocol and rarely by other protocols [1]. In particular, the availability and reliability of the internet infrastructure has accelerated the development of synchronous web-based applications in which groups of users can interact at a common (virtual) place and time.

The main goal of a CE is to bring together the right people and the right data at the right time in order to perform a task, solve a problem or simply discuss something of common interest [2]. The need for CE is driven mostly by the need to join geographically dispersed corporative or scientific teams. The first who adopted such systems were various businesses. CE gives the ability for the company-wide global teams to identify the source of a problem and to develop a fast response. This tiny detail in organizational structure saved many companies from disaster [3]. Further positive

experience accumulated was broadening to cover web-based learning systems, trading and marketing platforms, customer support and help desks.

1.2. Collaborative Environment – a working definition

The definition proposed here is based on the following typical characteristics of a CE: the ability of individuals to meet each other, the ability to generate new knowledge and the fact that both processes are technology supported.

The following definition of collaboration gives an appropriate exposure of the first two characteristics: *"a process of joint creation where two or more individuals with complement skills gain knowledge never possessed by any of them before"* [5]. In other words, this is a *creative* meeting, not just *any* meeting. It reflects the most important features of the collaborative environments, i.e. *joint creation* and *gaining new knowledge*. Collaborative environments are those where people meet each other not only to exchange information but to work out some new knowledge. This puts a delimiter between just a forum and a collaborative environment. CE should have technical capabilities for supporting such a process. As most CEs are based not on one, but on a set of technologies, the definition should reflect this fact. The concept *set of technologies* will be used to denote the limited set of all possible technologies used in an interaction process. Thus, a CE is defined as: *"A set of technologies that support the process of joint creation, where two or more individuals with complement skills gain knowledge never possessed by any of them before"* [1].

2. Instrumental structure of a CE

2.1. Tools survey

Basically the CEs are synthetic heterogeneous structures consisting of many standalone instruments (tools) governed by common choreography. The types of tools used are not unique in every CE. Our survey covered an excerpt of 29 CEs selected from more than 200 CEs. The main goal was to enumerate the set of all kind of tools serving as building blocks of CEs. In addition to the qualitative information about diverse tools, extra quantitative information was also collected. For example, the *frequency* of appearance of a tool, i.e. the number of times a given tool is met in a set of CEs, as if we put all the tools in a bag. This bag is like purse of money. Two bags B_1 and B_2 may be combined to form a single bag $B_3=B_1 \cup B_2$. The results are presented in *Table 1,* that has a "bag" structure:

[1] This definition is solely for purposes of the current paper.

Table 1. A Cross Table for the studied Collaborative Environments, the unique tools and their frequency of appearance (excerpt from the full table)

Collaborative Environments / **Tools**	@Task	BSCW	BrightSuit	EPMAC	Facilitate.com	FirstClass	.....	Lotus Domino	Netscape Collabra	phpCollab	ProjectDox	Proiistics	Quicktranet	Realization systems	Simlify	SiteScape forum	TeamCenter	Teamspace	Teamware office	**The frequency the tools were used, %**
Outlook Palm/Sync							.													0.3
Announcement							.													0.3
Bulletin board							.	•	•						•	•		•	•	2.5
Employee directory							.										•			0.8
.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
VoIP							.													0.3
Community Folder		•					.	•							•	•				1.8
Document/file Sharing	•	•		•		•	.	•	•	•			•		•	•	•	•	•	5.3
Document Management		•	•				.	•	•	•			•		•	•	•	•	•	4.3
Versioning		•	•	•			.	•			•						•			2.0
Meetings (eMeeintgs)	•		•				.	•	•							•	•			1.8
Chat					•		.	•					•					•		1.5
Calendar		•	•	•		•	.	•							•	•	•	•	•	3.5
Reminder			•				.	•							•	•	•	•		2.3
Help Desk			•				.	•									•	•		0.8
Resource Reporting	•			•			.					•					•			1.3
Ad-Hoc Reporting	•						.													0.5

2.2. Tools' frequency analysis

To answer a question like "Why *Calendar* tool could be met in almost every CE, while *Attendance report* tool is rarely known?" we should find how frequently a given tool is used in CEs. The frequency ($\boldsymbol{F_i}$), [%] of using a particular tool ($\boldsymbol{i}$) is calculated by the number of times ($\boldsymbol{k_i}$) it was found in a set of CE's:

$$F_i = 100.\frac{k_i}{\sum_{j=1}^{n} k_j} \qquad (1)$$

Many of the tools mentioned in *Table 1* have overlapping features. Detailed review anyway reveals enough diversity in behavior to give them relatively independent status. The criterion for the division of the tools is semi quantitative and only first ten are claimed to be *popular*, all the rest are considered *specific*. In fact the group of the first

ten tools (Zone 1, *Figure 1*) has twice more frequent usage than the group of all other tools (Zone 2 , *Figure 1*).

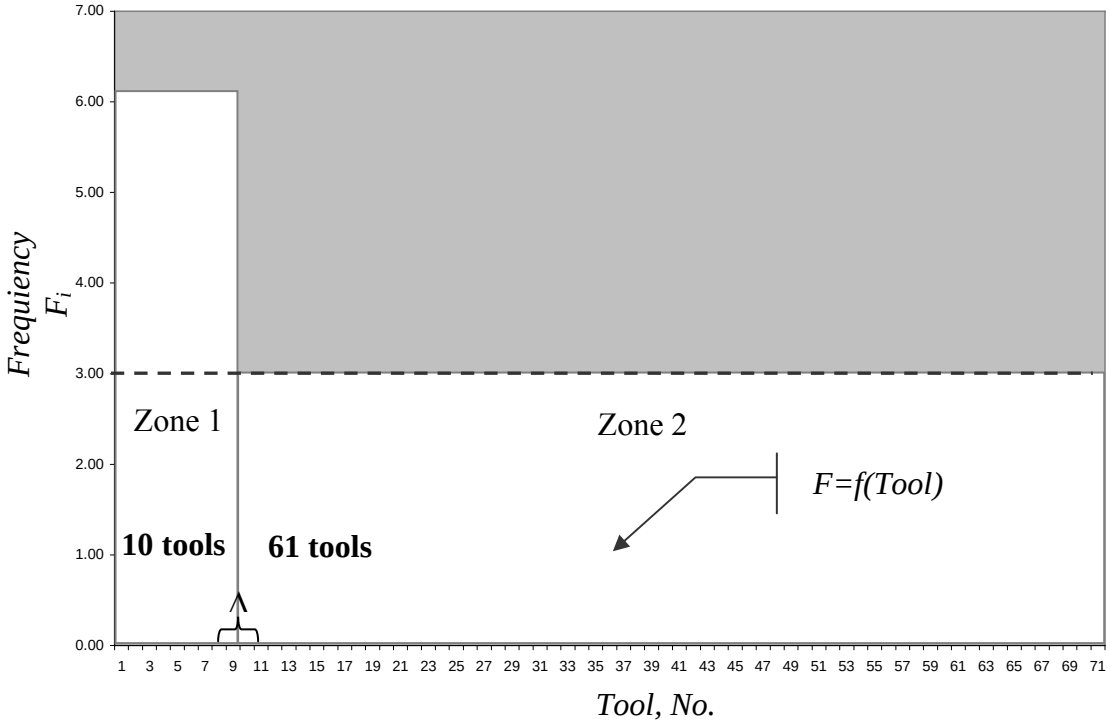

Figure 1. Interpolation of frequencies, F=f (Tool) for each tool in the excerpt

Thus the set of the following tools {Document Sharing, Project Management, Conferencing, Notifications, e-mail, Task Management, Calendar, Instant Messaging, Contact management} further will be considered as set of *popular tools*. Dividing features of a CE on such categories will reveal which of them rely on traditional, well polished structures, and which of them invest in innovations. Presumably those of them who tend to explore the opportunities of new technologies, in the future will serve more and better their customers, while the others will gradually become outdated.

2.3. Clustering and classification of CEs

Based on the information from such classification (2.2) the following chart could be built (*Figure 2*):

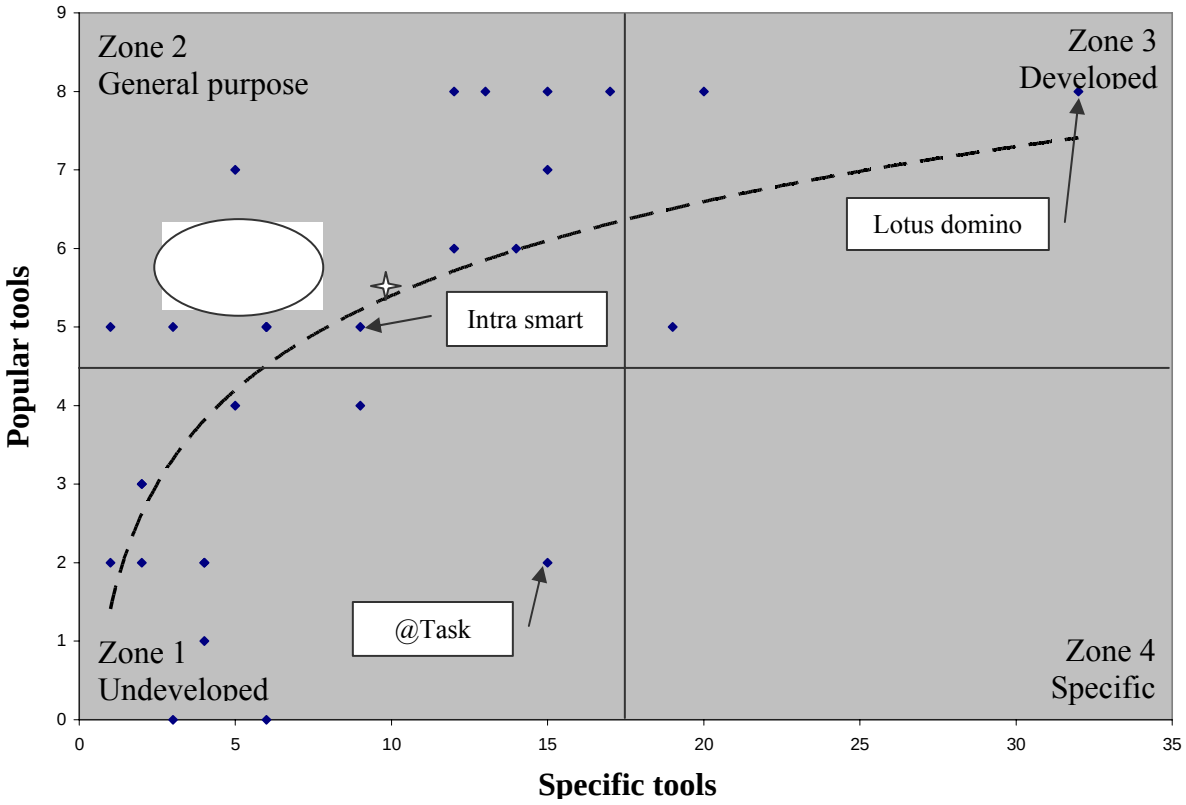

Figure 2. Number of tools falling in each of the specific and popular categories

This is a two-dimensional cross section of the function of the CE's diversity *g(x,y)* by two independent variables x and y – quantitative expression of the specific and popular tools used in a particular platform. The generic expression for measuring the distances in clusters is [6]:

$$d_r(j,k) = \left(\frac{1}{n} \sum_{i=1}^{n} \left| X_{ij} - X_{ik} \right|^r \right)^{\frac{1}{r}}; \qquad (2)$$

$$r = 2$$

When r=2 in (2), the term for taxonomy distances between members of a population is obtained. To find which CE is the most typical representative of a population, we have to find the minimal Euclidean distance for each pair CE's. The proximity of pairs is calculated as follows:

$$\min d_{ij} = \min \sqrt{\sum_{k=1}^{n} (x_{ik} - x_{jk})^2} \qquad (3)$$

The population analysis has shown that the most typical representative of current CEs is "*Intra smart*". It is the closest neighbor to any other. The system delivers only basic tools to support interaction. Near "Intra smart" is the *Population center* - the point, where the population is most dense (the 'star' in Zone 2, Figure 2*)*.

For the sake of simplicity we have used not actual frequencies of tools but just their quantity in the "bag". As example "@Task" possesses 2 popular and 15 specific tools (Zone 1, *Figure 2*). This scarifies some precision as the "bag" and frequency actually correlate on about 80%.

2. 4. Remarks on functional distribution of CE's

The points on Figure 2 resemble a little "galaxy", where most of "the stars" are situated around the galaxy center but a few of them break away in the space. Lower left quadrant contains primitive, undeveloped CE's (Zone 1, Figure 2). This quadrant also appears to be the starting point in a CE lifecycle. Most platforms begin their life with a few tools. Gradually they unfold tools basis and move toward lifecycle line. Of course many CE's freeze at this level and don't move any further.

Along the lifecycle path CEs become "older". The most developed CE on the chart is *Lotus Domino* - in fact it is one of the oldest systems (Zone 3, Figure 2). This leads to conclusion that creating a "best brand" CE is a time consuming effort.

Concentration in the area of popular tools (Zone 2, Figure 2) could be explained at least in three ways. First, the communities need these tools indeed. They are ubiquitous and well understood by users. Second, most of the platforms descend from a common predecessor thus inheriting many of its features. Third, most CEs share the same architecture which in turn defines similarities in their behavior and instrumental depot.
The emptiness of the lower right corner (Zone 4, Figure *2*) shows that there is no CE designed to support specific tasks. The only runner in this direction is *@task,* an enterprise level project management system possessing plenty of specific tools. It is no accidental that Sun Corporation and Novel have chosen @task to be their project management platform.

So, hardly any innovative or designed for specific tasks CE exists. The appearance of such CE will be easily exposed as it will occupy a place somewhere in "wilderness" of lower right quadrant.

An interesting experiment would be tracking of a CE during its lifecycle. This could be done easily by marking the place where CE is before and after it changes. These two points form a vector with a given length and given direction that prognoses the future development of the CE.

3. A Model for evaluating CEs and choosing an appropriate CE for a concrete context

Below a Model is proposed for evaluating a given CE with respect to its tools. It provides a practical way for choosing an appropriate tool for a concrete context. Those who are not interested into details could have skipped the above discussion and just use the model below as a black box.

The process could be described step by step as follows:

1) Select a CE. It could be any of your choice, or recommended by a specialist, or just found accidentally while browsing.

2) Enumerate the tools it has. During the exploration of the CE you have to compile a simple list of all its tools, either on paper or using preferred software.

3) Assign each listed tool to one of the two categories - typical or specific. This could be done by simply using the set of popular tools identified in section 2.2**.** If the tool matches this set, then it is popular, otherwise it is specific.

4) Count the number of tools in each category. After performing step 3, you will probably have something like "popular" – 6, "specific" - 3

5) Find the position of the CE on Figure 2. Measure the distances (using the numbers identified in step 4) on the "specific" and "popular" axes and find the crossing point, i.e. the place where the CE is positioned.

6) Make a conclusion. To make a conclusion if this particular CE is appropriate for the concrete context, one could refer to section 2.4 above or make her/his own interpretation.

Of course, the above model shows only tendencies. It is not an instrument for precise judgments.

4. Conclusion

The diversity of environments available nowadays could be considerably misleading for those who try to select one. Even simple attempts to classify CEs by functional characteristics would reveal existence of a few major groups. In case the user requirements are not satisfied by members of these groups, further digging in this

direction will cost much more than the results obtained. One possible choice is to rely on an open source solution - as a basis - and develop it further to comply with the needs. Before making such decision though, the time factor should be considered, as the aging effect in CE development is significant.

The above analysis shows that CE's are still user-centric but not task-centric. They are suited well to comply with user needs, but miss task compatibility. This reveals that while CE-to-user interfaces are sufficiently well developed, CE-to-task interfaces need further development. There is a niche for task-specific-CEs. It is not enough to provide tools to users and hope that they will use them effectively. By focusing on the individual or social needs of the users in the context of a collaboration task a common choreography will be able to adapt to the requirements of the concrete situation and to deliver best matching needs/abilities regardless of task, technology or individual [4].

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