Traces, Assistance and Communities, a review
Kolflow project - Task 4 - State of the art (D4.1)

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This paper present the state of the art for the task 4 of the Kolflow project. This state of the art focuses on 3 notions: the notion of Traces and Trace Base Management Systems, the notion of Assistance and the notion of Virtual Communities and Social Networks. This state of the art is not a general study of these different concepts. It was done by studying different concepts in the context of the Kolflow project.

1 Traces and Trace Base Management Systems

1.1 The notion of trace

General definitions. Some studies are available on the notion of "traces" as [41, 70, 56, 30];
In short a trace can be considered as:

- an *index* of somewhat; not the "what" itself, but something able to be an index for this "what", as long as the right keys of interpretation are available;
- an *inscription* of something in the environment such as it can be observed; hence, this "something" gets a physical mode of existence; it can be considered as a new thing in the environment, with ways to process it in some ways.
- a *layout*, a formal configuration transforming the footprints through a framework allowing to see them as a statement, writable and readable.

In the first analysis, we consider that a *trace* is made from imprints left voluntarily or not in the environment as a result of a process. The trace is built (or not) in the environment, used as an inscription support and a memory support. The nature of imprints is highly variable and any process can produce (or not) more or less persistent imprints, embedded in the environment but distinguishable by knowledgeable observers as a record of the initial process.
Hence, *observation* is a cognitive process allowing to consider a set of imprints as ONE trace of "something" that makes sense for the observer. The observer must therefore know (in one way or another) the *traced thing* to distinguish, interpret, operate such traces. Hence, traces take the status of knowledge inscriptions.
We propose therefore, arbitrarily and for convenience at this level, to name *imprint* the registration mark of something in the environment during the activity (activity time), and *trace* a set of such imprints considered as "trace of something" at the observation time (observation time can be the same time than activity time).
The observer often try to assign a *timestamp* to imprints, and so trace's elements are temporally located within the trace, but it is not mandatory for any trace.

Digital traces. If we use the general definition of the trace and we specialize it for digital traces, the corresponding definition would be: Digital trace is made from digital imprints left voluntarily (or not) by the digital environment in the digital environment itself during the digital process. We let *(or not)* even if it is not possible to let an imprint without executing some instructions to do it. The *(or not)* means that the designer of the program corresponding to the observed process can to be not aware of imprints which could be written in the digital environment by other codes than his/her ones (for debugging purpose for example). A very big difference with the previous definition is that anything is digital, and has to be *coded* somewhere to be written in the environment.
Several specific properties have to be pointed out:

- Processes, imprints, traces, etc. anything has the same digital nature and has been *coded*, which means that there exists explainable models, even if it is hardly possible in general to get them during a digital process.
- On one specific computer, anything can be time stamped without effort. This is not so easy for a distributed digital environment.

The environment is fully digital, codes can be explained with corresponding models (even if it is hardly possible in general).

Representing digital traces. With digital traces becoming first-class citizens on the web (with blog rolls, twitter feeds or the Facebook timeline[1]), semantic web technologies are increasingly called upon to represent them. [72] propose a very generic ontology to represent time-bound events, while [13] extends the SIOC ontology to represent the dynamics of online communities. [22] uses RDF, OWL

[1] http://www.facebook.com/about/timeline

and SPARQL to represent a user's browsing history, make inferences about it and transform it into more abstract and meaningful trace.

1.2 Traces in use

Trace-Based Systems (TBS) can be traced back to Schank's dynamic memory model [68], where case-based reasoning is performed on episodic knowledge acquired through actual experiences.

Stream Mining is the process of extracting knowledge from continuous records. By interpreting continuous records as digital traces, a TBS may be used to improve the results of the mining process. See [31] for a review on Stream Mining research, and [48] for a discussion on how exploitation of modeled traces can improve the mining process.

TBS can also be used to facilitate activity analysis and modeling. See [28] and [80] for fundamentals on knowledge mining and discovery from activity traces. Following these principles, [34] implemented a trace-based system to model the car-driving activity from traces collected with an instrumented vehicle.

TBS also proved to be efficient for user assistance [20]. First, traces are reflexive objects: users tend to find their own traces remarkably intuitive. [93] showed that merely replaying a trace provided an efficient form of assistance. Second, traces can be shared between users, which facilitates experience sharing. Third, traces can be transformed, which make them usable at different levels and in various processes [22]. Fourth, traces act as rich knowledge containers. They allow collection, management and restitution of knowledge. They share common properties with storytelling with regard to knowledge management. See [52] for a discussion about TBR and storytelling. Finally, traces enable contextual reasoning, by keeping for each of their element the precise time when they were observed, as well as the other elements that were observed at the same time.

TBS for user assistance have been specifically studied in the case of human learning systems [71]. Intelligent tutoring systems and collaborative learning tools are, by nature, designed to provide assistance to learners. These tools often use different forms of traces as an input for the assistance. In these tools, records of past experiences, as well as explanation, play an important role. The Visu application provides a good example of the use of traces in a collaborative learning space [7].

Digital traces and the web. References for this section: [3, 5, 10, 35, 36, 39]

The Web is becoming THE digital environment in which human activities, and specifically *knowledge oriented* activities are more and more realized. These activities let a lot of traces as digital productions (web pages, digital documents, messages, etc.) but also a lot of other not directly produced traces as logs, navigation historic, profiles, etc. These traces constitute a mine of knowledge for the web processes. Half the papers of WWW conferences are devoted to model behaviors in order to be able to adapt various web applications, services, processes. See for example http://www2012.org program.

If statistical information is usually what is searched by mining the web traces, there is a lot of applications for hypermedia adaptation: a profile is built from a current activity and applications are adapted according to the observed difference between it and the used profile by the application during the activity. These approaches do not take into account the user for designing the observation models or the adaptation models. Models are designed by experts, and the values of the profiles are either asked to the user either computed from the traces' mining.

Even if web traces are extensively used in more and more contexts, there is not yet a common field of research about web traces and their uses. Some recent conferences gather people on this question, and some research teams are proposing a specific approach for modeling traces and for managing them as a new kind of digital object.

2 Assistance

2.1 The concept of assistance

From a perspective of cognitive science, the concept of help might be defined as "an asymmetrical and instrumented relationship, between a human with a proposed action (desired, suggested or imposed) with modalities of realization ignored (or forgotten) and a technology supposed to make explicit the modalities, in such a way that they are appropriated by the person seeking help" [32].

[32] classify four modalities for this "human/technology" coupling:

- the **substitution**: when the technology supports independently the totality or a part of a task;
- the **supplementation**: when the use of the technology increase the action possibilities of the user and we can observe new schema or invariants;
- the **assistance**: when the technology is not crucial for the main activity. The main role of the technology is to facilitate or improve the use of the main tool;
- the **support**: when the technology allows to support the appropriation and the use of a new schema by the human.

The artifacts for assistance "human-technology" coupling can be distinguished according to [24]:

- **advisor system** vs **assistant systems** [69]. In this distinction, the advisors provide information, offers solutions, but are not directly involved in the task. Conversely, the assistants are dedicated to the execution of repetitive tasks.
- **conversational systems** vs. **autonomous systems** [45, 69]. Conversational systems require on the part

of the user, the expression of questions, which are associated with logical expressions, eg, queries. Autonomous systems operating in the background and have a proactive nature of the suggestions;

- **the ability of the system to improve itself** [46, 79].

2.2 The dimensions of the assistance

To define an assistance system, several dimensions must be considered. These dimensions relate to two separate problems: the presentation of assistance to the user and the way to define assistance algorithms [64]. The presentation of the assistance may be differentiated by the following characteristics [64]:

- When to assist? If every click by the user indicates a potential action, the question arises of when the user should be assisted. Assistance can be generated proactively (i.e., before an action), during actions, or after actions, and presented on demand or on request.

- How to assist? As modern computers often represent multi-media work environments, the form of media used by the assistance can be differentiated. Currently, assistance can be presented textually, visually, acoustically, or as a video.

- Where to assist? The information offered by the assistance system might be wrapped in tooltips, pop-ups, tables, specific sound effects, blinking effects, sidebars of a document, or specific marked spaces. Furthermore, it can be presented within the active tool, a specific third-party tool, or in the operating system itself.

- Why to assist? Assistance may be proposed for many reasons: during the identification of a lack of user's competence, when the task is complex, when the new feature is available, etc.

Similarly, for the definition of assistance algorithms, several features are considered [64]: assistance for whom? Assistance about what? Assistance in which process? Assistance in which tool environment? These different dimensions show, in order to provide context-sensitive assistance, it is necessary to have at least information about the task, skills and preferences of the user and the tool.

2.3 Adaptive assistance systems

In the majority of research on the assistance, assistance is designed as the system's ability to provide an answer to a problem posed by the user. The role of the user is limited to provide the information needed to find a solution [90]. This design of assistance is criticized because [11]:

- It does not allow the acquisition of additional knowledge to the user

- It is contrary to practical assistance in a real situation of guiding the user to find the solution rather than directly provide this solution [18]

- It does not allow the dialogue between human and machine that can guide and improve the search for solutions [67].

To overstep these limits, other types of assistance have been proposed (task allocation, critical systems) for a more interactive problem solving. Thus, [47] proposed a assistance system that does not try to find the optimal solution but which guides the user to develop his own solution from the state in which they are located. The assistance system can then provide the user assistance in the optimization to achieve the optimal solution.
To improve the assistance to users and thus to adapt it to their changing needs, assistance systems must be able to increase their knowledge [19]. But, according to the "human/technology" coupling, the combinatory of unpredictable situations make an *a priori* assistance definition really difficult [53].
Most of research approaches aiming to define "intelligent assistants", the intelligence consists in the implementation of reasoning mechanisms to facilitate or automate some tasks. These assistants are based on the use of predefined knowledge and strategies. They can not evolve to adapt themselves to new situations and provide assistance on issues not anticipated by their designers [19].
However, adaptive tools are designed to adapt themselves to users [85]. These tools are able to automatically change their characteristics depending on the needs of users [57]. These tools are particularly relevant in contexts where users need to quickly appropriate environments, as they are sometimes unaware of their own needs. Adaptive tools exploit the knowledge they have on users to adapt their behavior. They also use knowledge of the domain and the application in order to make inferences and identify the elements of the application that can be suited to the user. Thus, adaptive tools are focused on how the user interacts with the system and how the interfaces can be adapted to facilitate these interactions.
Using Trace-Based Reasoning [51], it is possible to overstep the limits of these two approaches and to propose assistants able to adapt to user needs as well as context changes [12, 58, 20]. In order to do this, Trace-Based Reasoning (TBR) proposes to reuse the principles of Case-Based Reasoning to exploit unstructured experiences [51]. In the paradigm of TBR, the traces of interactions between user and the application are collected and stored by a Trace-Base Management System. These traces are used as containers of knowledge that keep the information on experiences "in context". It is the role of reasoning mechanisms that extract from traces the necessary knowledge to the assistance. TBR naturally relies on the interactions between the user and the application to provide an answer to the problem of the evolution of knowledge contained in the as-

sistants [20].

2.4 Assistance to end users on the Web

The assistance to end user on the Web may include Web form input operations [92, 21]; the adaptive presentation of content [89]; the navigation within a website [76, 77, 65]; Information or Website Retrieval [50, 23, 49]. This assistance can be client-side or server-side, depending on user profiles; the history of user actions (previous input, logs, more complex traces); and the content of webpages.

2.5 Assistance to the co-construction of meaning

Co-constructing of meaning between human and machine or between machines. One of the ways to improve the assistants is to allow the construction of a mutual sense between assistant and user [75]. This man-machine co-construction of meaning is based on a negotiation process. The negotiation of meaning between human and machine or between machines is an important topic in AI research.
In 2000, Steels was a synthesis of work in this area [73]: the emergence of a shared language between two agents (specifically, a grammar) is possible through language games allow interaction between the two agents.
These principles were re-used by Stuber to allow a user to negotiate, via a graphical interface, meaning with his assistant [75]. This interface allows the user to manipulate symbolic interpretations of the relevant parts of his traces of interaction with the system. This interface helps to negotiate the common meaning of the symbols to lead to a consensus between machine and human. The agreement of shared meaning between human and machine allows the assistant to be more effective.

Co-constructing of meaning between humans mediated by a machine. This negotiation of meaning between humans can be seen as a collective decision-making [8]: no attempt is the best solution but the solution that suits the majority. This negotiation is a unpredictable collaborative mechanism and the mediating of this process has also been the subject of much research [81, 82].

2.6 Assistance in the design of ontology

The creation of ontology consist in translate human expertise in language understandable by the human designer and to represent them operationally to help accomplish a given task [37].
Many researches use ontologies to provide user assistance [1, 6, 14] but research on assistance during the creation of ontology are less common. In this case, user assistance consist often in provide graphical tools to support the creation.
These tools help designers at different steps of the design. Some allow experts define these ontologies to "discuss" during the design phase [78, 27, 25, 55].
Other tools help experts to formalize ontologies as Jambalaya [74] or Protégé [55]. These tools support the creation, visualization and manipulation of ontologies in various representation formats. They can work on multiple ontologies but the tools proposed to merge two ontologies are very limited. No tool can automatically resolve conflicts that may emerge from the merging of two ontologies. Current tools merge ontologies and allows users to resolve conflicts.
To help users manage these conflicts, it is necessary that users understand the ontologies used. Assistance is therefore to question the type of explanations that will be understandable by users. Indeed, an ontology is defined using the representation of its designer. This representation is not necessarily understandable by other humans who do not have the same initial knowledge. Provide traces of design or use of an ontology use is not always sufficient [37]. For this reason, several researchs [37, 11] proposes to provide the assistance system of a user model to determine the needs and the mode of reasoning of the user to assist. This model can then be used in problem solving dialogues (such as conflict management) or in the dialogues of knowledge transfer (such as explaining a part of an ontology) [11]. These research propose adaptive assistance systems with an model of the interlocutor to adapt the dialogue at the level of competence of the user.

3 Virtual communities, social networks: definition, knowledge sharing, systems

3.1 Definition of a virtual community (online community, social network)

In the literature, many researchers define Virtual Communities (VC). For example, [4] define it as any entity that exhibits all of the following characteristics:

1. an aggregation of people,
2. rational members,
3. interaction in cyberspace without physical collocation,
4. social exchange process,
5. and a shared objective, property/ identity, or interest between members.

[42] defines a VC as "a group of people with common interests or goals, interacting for knowledge (or information) sharing predominantly in cyberspace." [60] defines it as "an aggregation of individuals or business partners who interact based on a shared interest, where the interaction is at least partially supported and/or mediated by technology and guided by certain protocols and norms".
Virtual communities are also called online communities, defined as "a group of people, who come together for a purpose online, and who are governed by norms and policies" [61] and as "any virtual social space where people

come together to get and give information or support, to learn, or to find company" [62].
Other authors define Virtual Communities (VC) as a specific type of online social network, in which people have common interests and goals. For example, [29] defines a virtual community as "social relationships forged in cyberspace through repeated contact within a specified boundary or place (e.g., a conference or chat line) that is symbolically delineated by topic of interest". [17] defines VC as an "online social networks in which people with common interests, goals, or practices interact to share information and knowledge, and engage in social interactions".
So a virtual community emerge on an online environment, is governed by norms and policies and gather people who have common interests and/or goals and so develop social relationships by exchanging information and sharing their knowledge.

3.2 Different types of virtual communities

A virtual community is structured. According to the type of community, the structural elements are different, depending on the activity, on the degree and the type of participation, on the goals, on the type of learning or on the duration. There are different types of virtual communities. In the literature, the most studied communities are community of interest, learning communities and community of practice [59]:

- **Community of interest**: group of people who gather on the Internet or elsewhere and have the same interests or concerns, such as chronic health problems. Communities of interest emerge more or less spontaneously, without fixed duration, for sharing ideas without common learning goal. They are characterized by an individual commitment and the absence of a collective problem solving.

- **Learning communities**: emerge on the initiative of an educational actor (e.g. teacher, administrator) as part of a course with learning goals. For example, a learning community could be a group of learners who are organized around a learning project or a problem solving learning situation. This type of community is characterized by a willingness to learn together (guided by the teacher), with a collective problem to solve. The duration is usually related to an activity, a course or a training.

- **Community of Practice (CoP)**: group of employees within an organization or several organizations, exercising the same profession, who work outside the framework established by their organization, for an undetermined period. In general, these people are interested in improving the conditions of their practice by solving problems collectively and in developing their professional practice (the novices learn from the expert). The term communities of practice was first utilized by [9] and by [43], and was later popularized by Wenger and his colleagues [86, 88, 87]. According to [87], communities of practice are "groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis". [33] take up these main characteristics of virtual CoPs:

  1. Members share an interest, roles, a concern, a set of problems or a passion.
  2. They aim at building up the members' skills and deepening their knowledge and expertise.
  3. Members acquire a common identity.
  4. They need a specified boundary or place.
  5. Practitioners define common knowledge, practices and approaches.

3.3 What is success for a virtual community?

The success of a virtual community could be measured regarding:

- The participation: participation usually means members' contribution to some specific activities or events, members' posting behaviors, and members' lurking behaviors (a form of passive participation) [16].

- The intention to continue sharing knowledge [26, 94].

- The level of knowledge sharing [17].

- Members' willingness to share knowledge with other members, loyalty of the members to their communities [40].

- To keep members using the information in the network [16].

3.4 Factors influencing knowledge-sharing behavior in virtual communities

[17] distinguishe:

- **Social capital**: social interaction ties, trust, norm of reciprocity, identification, shared vision and shared language. Following [54], [17] define social capital with three distinct dimensions: the structural dimension is manifested as social interaction ties between actors, the relational dimension is manifested as trust, norm of reciprocity, and identification, and the cognitive dimension is manifested as shared vision and shared language.

- **Outcome expectations** (community-related outcome expectations and personal outcome expectations). According to [54], self-efficacy is "a judgment of one's ability to organize and execute given types of performances," whereas an outcome expectation is "a judgment of the likely consequence such performances will produce".

[91] have reviewed several aspects of knowledge-sharing in the VC including **individual, knowledge, and environmental aspects**.

[40] distinguishes **contextual factors** (norm of reciprocity and trust) and **personal perceptions** of knowledge sharing (knowledge sharing self-efficacy, perceived relative advantage, and perceived compatibility).

[94] differentiates **inherent motivational factors** [84] and **interpersonal conditions** that can shape knowledge-sharing behavior: social capital [84, 17], social cognition [17, 38], trust [66], satisfaction [66], or attachment to collective action [84].

[91] have concluded that **trust, system usability, enjoyment of helping others, self-image, and knowledge self-efficacy** are critical drivers underlying member knowledge sharing.

The following factors have been identified in the literature:

- **Individual perceived attributes** (knowledge sharing self-efficacy, perceived relative advantage, and perceived compatibility) influence member knowledge sharing in virtual communities and organizations [84, 17, 38]. Self-efficacy has both direct and indirect effects on knowledge sharing behavior, implying that self-efficacy plays a critical role in guiding individuals' behavior [38]. According to [40], trust significantly influences personal perceptions (knowledge sharing self-efficacy, perceived relative advantage and perceived compatibility), which in turn positively affect knowledge sharing behavior.

- **Trust.** Trust has been identified as a key element in fostering the level of participation or knowledge sharing in virtual communities [2, 66, 91]. According to [94], trust is an important antecedent of psychological safety, and therefore it not only has a direct effect on knowledge sharing, but also plays a partial mediating role by promoting the feeling of psychological safety.

- **Psychological safety.** [94] defines psychological safety as "one's emotional ability to express oneself in a virtual community without fear of negative consequences in relation to well-being, self-image, and status" and show that both trust and psychological safety have a positive effect on members' intention to continue sharing knowledge in virtual communities, and that psychological safety partially mediates the impact of trust.

- **Community-related outcome expectations** play an important role underlying knowledge sharing in terms of both quantity and quality [17]. According to [38], personal outcome expectations also have significant influence on knowledge sharing behavior. According to these studies, "community-related outcome expectations refer to a knowledge contributor's judgment of likely consequences that his or her knowledge sharing behavior will produce to a virtual community, while personal outcome expectations refer to the knowledge contributor's judgment of likely consequences that his or her knowledge sharing behavior will produce to him or herself."

- According to a **social capital perspective**, [84] show that **reputation, altruism, general reciprocity, and community interest** are significant motivators of knowledge contribution. People contribute their knowledge when they perceive that it enhances their professional reputations, when they have the experience to share, and when they are structurally embedded in the network. [17] show that social interaction ties, reciprocity, and identification increase individuals' quantity of knowledge sharing but not knowledge quality. [40] argue that the norm of reciprocity is a significant determinant of trust in knowledge sharing. That is, the norm of reciprocity is normative and supportive of knowledge-sharing initiatives in PVCs (Professional Virtual Communities). Members are more likely to display confidence and reliability in each other's actions in relation to knowledge sharing.

- **Knowledge resources and quality** have been demonstrated as a performance or outcome of knowledge-sharing behavior in a VC [84, 17]. Knowledge-sharing/exchange has long been regarded as a motivation for using virtual communities [83].

- **Sufficient knowledge**: Knowledge in virtual communities is mainly created by their users through their knowledge-sharing behaviors [44]. Without the availability of sufficient knowledge, people may be reluctant to participate because the virtual community cannot fulfill their knowledge needs [83].

- **Satisfaction and information usefulness** (they perceive that the information in the network is useful) [16]: both information quality and source credibility are important determinants of information usefulness.

- **System usability** [62, 91].

The results of the studies are difficult to generalize since each community has its own properties. For example, many studies are contextualized in virtual communities that are **open to the public** (named hereafter public virtual communities), such as public professional communities [17, 15, 40] and Yahoo! Groups [83, 66, 38]. These public virtual communities are often characterized by **open membership, anonymity, and little or even zero offline interaction** [38]. However, there are also other kinds of virtual communities that are **built within a particular organization**, such as a university, to support the learning and knowledge exchange of its existing members only: their membership normally is not open, participants may know some others at a personal level and may even have face-to-face interactions, the activities in these virtual communities are identifiable to individuals in their real life [94].

3.5 Why lurkers did not post and advice increase participation? [63]

- Didn't need to post. A large number of lurkers feel they do not need to post because they get what they need.

  Encouragement to post: Explicit comments; Moderators' encouragement; Reward quality and quantity of contribution; Support for browsing.

- Needed to find out about the group. The need to get to know the group before posting was expressed by several participants directly. Some also talked about the need to develop trust in the community, which can be interpreted as needing to get to know the group more.

  To help newcomers, established members could be encouraged to take on the role of the archetype "greeter". Other strategies could include guided tours, mentoring, and discussion summary pages. Personal information pages and links to individuals' home pages or a who's who directory may also encourage newcomers to feel more empathy towards group members.

- Thought I was being helpful. Some people thought that by not posting they were contributing to the well-being of the community.

  One way to involve these altruistic lurkers is to provide software that reduces the cluttered and confusing interface usability problem. People need to register their opinion without crowding and complicating the interface. One solution might be for participants to add a vote to the opinions with which they agree.

- Couldn't make the software work. Poor usability caused problems for the participants and may explain why some of them did not post. Some people had difficulty getting into the community or didn't like the process.

  Usability was a problem for some users as we stated in the findings: Usability support for newcomers; Dealing with too many messages.

- Didn't like the group (poor dynamics/fit). There were many comments that referred to poor group dynamics. Several people also felt they did not fit in the community or they would not be accepted into the community.

  Five main types of problems that moderators, community participants and software developers can address: shy about posting; Want to remain anonymous; Wrong group; Fear of being treated poorly; Poor quality interaction.

3.6 Advice to design an environment for online communities

[62] advance that online communities support has to be designed according to usability and sociability criteria:

- **Sociability:** developing software, policies and practices to support social interaction online. Three key components contribute to good sociability [61]:
  - **Purpose.** A community's shared focus on an interest, need, information, service, or support, that provides a reason for individual members to belong to the community.
  - **People.** The people who interact with each other in the community and who have individual, social and organization needs. Some of these people may take different roles in the community, such as leaders, protagonists, comedians, moderators, etc.
  - **Policies.** The language and protocols that guide people's interactions and contribute to the development of folklore and rituals that bring a sense of history and accepted social norms. More formal policies may also be needed, such as registration policies, and codes of behavior for moderators. Informal and formal policies provide community governance. [...]

- **Usability:** "The main usability issues for online communities are similar to those for most other web-based software but the following four components are particularly important because they are concerned with the software's role as a medium and a place for social interaction:
  - **Dialog and social interaction support.** The prompts and feedback that support interaction, the ease with which commands can be executed, the ease with which avatars can be moved, spatial relationships in the environment, etc.
  - **Information design.** How easy to read, understandable and aesthetically pleasing information associated with the community is, etc.
  - **Navigation.** The ease with user can move around and find what they want in the community and associated website. Many online community users have suffered from the inconsistencies of data transfer and differences in interaction style between imported software modules and the website housing the community.
  - **Access.** Requirements to download and run online community software must be clear. In addition, if high bandwidth and state of the art technology is needed to run the community there should be a low bandwidth text only versions and clear instructions about how to obtain it."

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