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Time, Narratives and Participation Frameworks in Software Troubleshooting

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Abstract. The paper problematizes diagnostic work as a solely technical and rational activity by presenting an analysis focused on the social and organizational practices in which diagnosis is embedded. The analysis of a troubleshooting episode in an Italian internet company shows how diagnostic work is realized: 1) through collaboration sustained by specific knowledge distribution among designers (different but overlapping competences); 2) intersubjectively and discursively as an activity characterized by specific and diverse forms of participation and interwined with material intervention in the system; 3) following a situated rationality which proceeds by gradual approximations to achieve partial or provisional solutions while also taking account of organizational goals and needs. In particular the paper discusses how diagnosis is shaped by time pressure, flexible roles and distributed responsibilities, absent participants, narratives as specialized discourses.

Key words: collaboration, diagnostic work, participation framework, situated rationality, narratives at work, decision making

1. Diagnosis as situated practice

Engineering diagnosis is traditionally considered to be solely an individual cognitive activity that can be improved through problem-solving methods or the study of hypothetical reasoning (see for example Benjamins and Jansweijer 1994; Das 2003; Sattar and Goebel 1990).

Many studies conceive diagnosis as a strictly sequential and rational work process (which includes cognitive tasks such as symptoms detection, hypothesis generation and discrimination, strategies generation and implementation; see Benjamins and Jansweijer 1994) and independent from the specifics of the organizational context and from non-technical engineers' practices. This framework is used to inform software systems that should assist with the diagnosis task, or to suggest logic-based behaviours that can support diagnostic work.

Observation-based studies of everyday technical work, by contrast, have found diagnostic work to be a much less standardized, individualistic, and rational

activity. Emblematic is Orr's (1996) study, which showed how the diagnostic process for copiers was essentially narrative and cooperative. Orr showed that the interpretation of technology-mediated events is an inevitably problematic and discursive activity, and that it constitutes a crucial component of professional competence. It is in fact through joint accounts and interpretations, within triangular relations which also include the technology itself, that technicians construct a repertoire of distributed knowledge and pragmatic understanding which is one of the most valuable and enduring outcomes of their collaboration.

Other ethnographic studies have shown that, as in many cases of engineering work, diagnostic activity is not separated from and does not necessarily follow the design of technical products (Suchman 1997). Studies on engineering design practices describe in fact, not the monolithic and sequential work process usually presented in the methods proposed for developing technological products, but a varied and situated activity (Button and Sharrock 1995; Bødker and Christiansen 1997; Suchman 2000; Mackenzie and Monk 2004). Among the different work practices described, we find, besides formal planning defined as "professional design", what has been called "design-in-use", that is, an activity of maintenance, troubleshooting and debugging of what has already been constructed (Suchman and 1997; Suchman et al. 1999; Alby and Zucchermaglio 2006). Both of these interdependent work processes are necessary for developing effective technological products.

Other ethnographies (Woolgar 1994; Sharrock and Button 1997; Sharrock and Anderson 1994; Martin et al. 2007) pointed out the relevance of the users to programming showing how developers try to figure out what their users require and then design their system to fit that and how the sense of every technical decision was made through an organizational frame (Button and Sharrock 1994, 1995, 1998; Grint and Woolgar 1997; Martin and Rooksby 2006; Martin et al. 2007). They also have shown that there is a difference between the *project on paper* and the *project in practice* (Bucciarelli 1994; Button and Sharrock 1996) and that designers always have to face a series of contingencies and develop adaptive responses (Sharrock and Button 1997).

The emerging of new user-centred collaborative software design approach (such as Agile or Extreme Programming) and the studies of such methods in practice (Mackenzie and Monk 2004; Sharp and Robinson 2004; Martin et al. 2007) contributed to change the idea of programming as an individual and mental activity by showing how cooperation results in better design and better code. Even if it is argued that "there is still little understanding of why [these methods] are successful or popular: agile methods may be the answer, but we are still unclear about what the question is" (Brown 2006:25). We believe that the increase of ethnomethodologically-informed studies of programmers' practices can help to ground these new methods epistemologically by showing how engineers reason and organize their activity in their everyday work. We would like to contribute to this enterprise through the analysis of an episode of troubleshooting in a small Italian company which

manages a portal. Among these web designers, troubleshooting is a frequent diagnostic routine performed through rapid coordinated action.

How is such coordination achieved? What are the features of such joint diagnostic activity? What shapes the outcome of the diagnosis? What knowledge is required by designers in order to face the problem?

Before illustrating the answers received by these questions in our research setting, we will briefly describe the organization and the methods used for data collection and analysis.

2. Entering a web design company

The company (henceforth 'Energy') is based in Italy and manages a portal that provides services to a mass audience (personalized homepages, news, e-mail, SMS, thematic channels, e-commerce, etc.). It employs around 40 web designers: the producers manage the editorial content, and the engineers the portal applications.

A 3-month ethnography enabled us to describe the organizational features of the firm which form the framework in which the analysis of diagnostic practices assumes meaning and salience. In the first month, we conducted a background ethnography in order to describe the everyday organization of work practices, and we carried out some interviews with key informants. In the following months we made video recordings of around 10 h of interactions, which were then transcribed making reference to the Jefferson notation (Jefferson 1989) and to Goodwin's (2000) visual analysis.[1]

Energy has an organizational culture typical of many Internet companies in which "speed" is more important than "perfection", as an engineer said during an interview (see extract 1).

Extract 1

1. Paolo:
la velocità è la cosa più importante, non la perfezione (...) è vero che i problemi non scompaiono ma ragionandoci troppo perdiamo altre opportunità
speed is the most important thing, not perfection (…) it's true that problems don't just disappear, but if we spend too much time discussing them, we miss other opportunities

This priority is also related to the type of market in which Internet companies operate (see extract 2).

Extract 2

1. Paolo:
forse sbaglio ma l'ambiente mi ha formato così. È un mercato sempre incerto, non si sa mai qual è il futuro (...) i progetti cambiano sempre, che me

ne importa di lavorare tanto su una cosa che forse si chiude! Noi stessi fra un anno potremmo essere chiusi!

maybe I'm wrong, but the environment has made me that way. The market is always uncertain, you never know what the future will be (…) plans change continuously, what do I care about working a lot on something that may close! We could even be closed in a year!

The firm is one of the few in the sector to have survived the 'dot com crash', even if the American parent company went bankrupt and all its other foreign branches were closed. Also this sensation of a precarious future influenced the choice to work for results visible in the short period. Moreover, the small size of the firm (recently reduced even further) facilitated a loosely structured way of working which would be difficult to manage in a larger firm.

All the web designers are working in a large shared room: this kind of spatial arrangement facilitates collaboration and communication among them.

3. Studying unfolding diagnostic practices

We will now examine collaborative diagnostic work done by the web designers during a troubleshooting episode in which "strange" contents (different from those originally inserted) were found on the website.

We choose this episode because it provides a good example of how diagnosis is not done privately 'in the programmer's head' but is instead the complex collaborative achievement of a team. In the data collected, this particular episode seemed to be particularly useful for studying the coordination's mechanisms: a) it involved in fact many designers who leaded the work in different moments; b) it was considered a situation of emergency (evaluated nine by the designers on a scale from one to 10), which therefore required a rapid collaboration (Buscher 2007); c) it was a 'compact', multi-voiced and public interaction: a diagnosis with a start and an end, which occupied the scene for about 20 min and was realized through an accessible team discussion (and not for instance distributed in emails or instant messenger).

The teamwork diagnosis can be divided, as we will see, into two parts: initially the designers conducted a superficial diagnosis aimed at rapidly finding a technical solution so that a "presentable" site could be shown to users; they then sought to deepen the diagnosis, understand the causes of the problem, and appraise whether a more enduring technical solution (one that prevented the problem from arising again) could be found (see also Fig. 1).

We now describe the two phases, focusing in particular on the diagnostic practices used and on their outcome. We subsequently analyse certain features that sustained this collaborative diagnostic work.

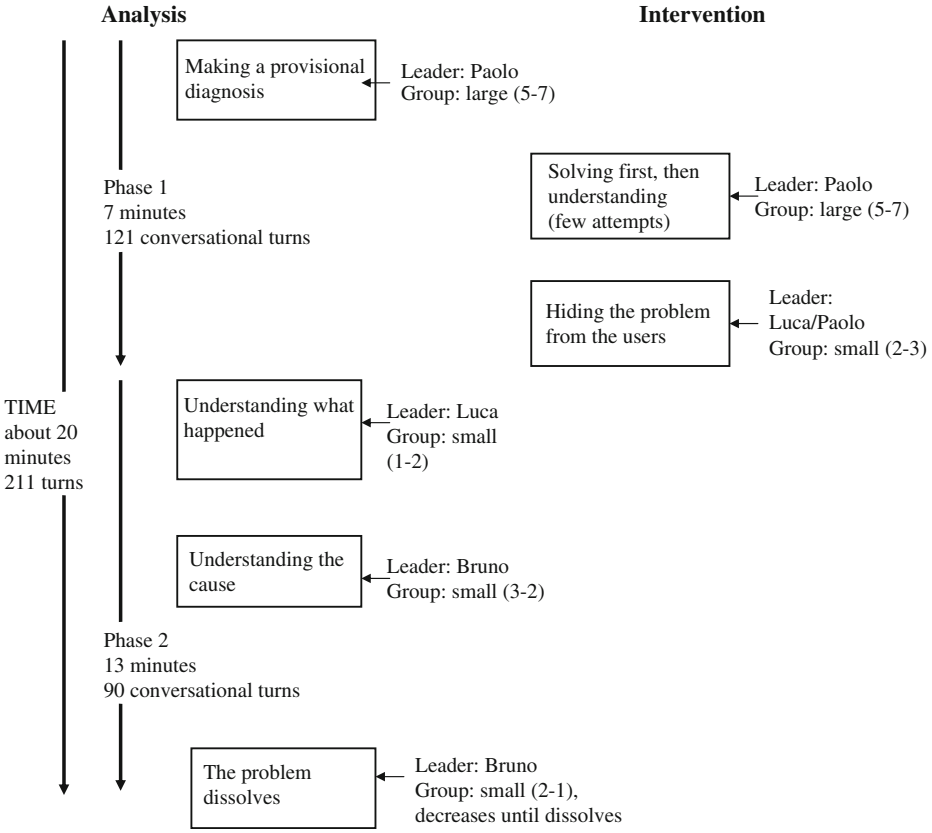

Figure 1. The local development of the diagnostic process.

Figure 2. Web designers start the diagnosis.

3.1. The relevance of the users in the diagnosis (phase 1)

3.1.1. *Making a provisional diagnosis*

The process started with Carlo, a producer, who went to Paolo, head of the engineers, saying, "Help Paolo, the site's down!" If there are serious problems regarding users viewing the site, the phrase "the site's down" said aloud in the open area of the office immediately calls attention to the problem and gives it top priority. A group of about seven people are gathered around Paolo's computer and desk (see Fig. 2).

The producers Gianna, Carlo and Lisa report what they were doing just before the problem appeared. They do not report any errors nor did they notice anything unusual.

The collective diagnostic process proceeds through direct action on the site. Various options are sequentially evaluated one at a time (Lipshitz et al. 2001), linking actions ("if I access without Tiger," see extract 3) and their visible products on the screen ("the page isn't broken," see extract 4). The first provisional outcome of the joint diagnosis is that the Tiger program, which allows the producers to publish contents on the website, seems to be involved in the problem.

Extract 3

1. Paolo:
   perchè guarda se io accedo a un link senza Tigre
   because look if I access a link without Tiger

2. Carlo:
   ssh:: sentiamo
   ssh:: let's hear

3. Paolo:
   se io accedo senza Tigre la pagina non è rotta
   if I access without Tiger the page isn't broken[2]

Having performed this preliminary diagnosis, although what exactly has happened is not yet clear, the designers decide to try repairing the Tiger program.

To do so rapidly (there are various explicit urgings on this: "we are losing time"), the designers decide to give priority to solving the "public symptoms" of the problem, rather than to analyzing and understanding what exactly happened (see extract 4).

Extract 4

1. Paolo:
   poi dopo possiamo capire che cosa andava storto ma adesso
   afterwards we can understand what went wrong, but now

2. Luca:
   adesso
   now

3. Paolo:
   mettiamolo a posto
   let's fix it

4. Luca:
   sò d'accordo
   I agree

The designers make changes to the Tiger program's code to see what will happen in the website. These attempts at repair support the diagnostic work and they seem gradually to approach the solution.

This strategy of repair jointly with the diagnosis is characterized by a sort of navigation-by-sight whereby the designers do not know where they are going until after they have seen the results of the intervention, and by a triangular relation between the designers and the website with its many applications (Orr 1996; Suchman 2002). This iterative interaction yields the diagnostic understandings which provide the basis for the subsequent interventions.

3.1.2. *The outcome: an apparent solution*

Although the repair/diagnostic strategy has produced some results, time pressure induces the producer Luca to suggest a more rapid solution. This consists of removing all the parts containing the errors managed by the Tiger program so as to obtain an extremely basic, but at least coherent and clean, site (see extract 5). The problem is not solved, therefore, but at least it is concealed from the users.

Extract 5

1. Luca:
   fa na cosa.
   do something.

2. Paolo:
   hm.
   hm.

3. Luca:
   in dcg togli tutta la parte fissa Tigre (2.0) lasciamo soltanto la parte personalizzata

in dcg take out all the fixed Tiger part (2.0) let's leave only the personalized part

4. Paolo:
okay. quindi forse salto [tutta]
therefore, maybe I'll cut [all]

5. Luca:
[eh]

6. Paolo:
questa sezione?
this section?

7. Luca:
si
yes

8. Paolo:
okay
okay

9. Luca:
al volo
quick

10. Paolo:
okay
okay

11. Luca:
tanto perchè qui la cosa è lunga
because this is a long story

12. Paolo:
va bene
okay

Finding this 'apparent' solution which deals with the problem as far as the users are concerned allows the group to start a phase of different and deeper diagnosis of the technical malfunction.

This first phase of the diagnostic process is therefore approximate and rapid: the repair actions are intertwined with the diagnosis, and they finally produce a

solution 'apparent' in the sense that is a solution that does not resolve the technical problem, but only the problem of visibility to the end users.

3.2. The program as actant (phase 2)

3.2.1. *Understanding what happened*

Now that the emergency concerning the visibility to consumers of the damaged site has subsided, the designers continue the diagnosis by exploring the site and clicking on the various links to gain better understanding of the problem.

This second phase is the one that more closely resembles what is traditionally meant by 'diagnosis': a careful exploration of the symptoms of the problem followed by examination of possible solutions.

While clicking on "my energy" (a link present on the site), designers discover that this link connects to contents different from those that the producers put on it. This discovery takes them an important step forward in the diagnosis (see extract 6)

Extract 6

1. Luca:
   lo sai cosa?(.)Paolo? vedi qua il mio Energy contiene invece cose (0.5)cioè, è proprio sbagliato il codice degli slot
   you know what?(.)Paolo? look here my Energy contains instead things (0.5) that is, the slot code is wrong

2. Paolo:
   quindi dici:: che forse c'è stato un errore di Tigre che ha mis[chiato]
   so you're saying that maybe there was a Tiger error that mi[xed]

3. Luca:
   [ha mis]chiato i contenuti
   [mix]ed the contents

4. Carlo:
   ha mischiato tutto [quanto]
   it mixed [everything] up

5. Luca:
   [guarda] dove è finito questo qua? ha scambiato=ha scambiato le cose Tigre
   [look] where did this end up? Tiger mixed=mixed things up

The designers understand what has happened, i.e., the Tiger program has started mixing the contents by itself. The program's agency gradually emerges until Luca's statement "Tiger mixed things up" (turn 5). Following this discovery, Bruno, another engineer who knows how to repair the program, joins the group.

Luca and Paolo start a detailed account of the diagnostic process. Bruno seems to be the main audience for the story. However, he has been present during large part of the process and therefore has no special need of this information. Instead, the collective account seems to have the specific function of permitting a shared reconstruction of the events, which is known to be crucial in diagnostic activity (Orr 1996).

This joint narrative permits the participants to question each other so as to reach reciprocal understanding and provide resources for interpreting the cause of the problem (see extract 7).

Extract 7

1. Paolo:

   non è:: non è chiaro quello che è successo. ci sono dei=dei log di Tigre che: h: possono [aiutarci?]

   it's not it's not clear what happened. are there Tiger logs that h: can [help us?]

2. Bruno:

   [si] (però cioè) si può vedere che ha fatto il push però:

   [yes] (but that is) however we can see what made the push

3. Paolo:

   non=non abbiamo modo di:

   haven't=haven't we any way of

4. Bruno:

   anche le eccezioni vai a beccarti (.) sono mega e mega di log

   you'll find even the exceptions (.) there are millions and millions of logs

5. Paolo:

   ah ntc.

   ah ntc.

6. Bruno:

   vatti a beccare l'errore! (1.0) ma in quel momento non c'era nessuno che faceva push? qualcuno proprio su un canale? uno slot?

   try to find the error! (1.0) but at that moment, was someone doing a push? someone on a channel? a slot?

It emerges from Bruno's words, that a thorough analysis of Tiger's behavior would take a great deal of their time ("there are millions and millions of logs."). The diagnosis would instead be simpler and more rapid if the problem were at least partly due to the interaction of the designer with the program—a hypothesis, however, that is apparently not confirmed.

3.2.2. *The outcome: leaving the problem unsolved*

The group devotes a certain amount of time to this type of investigation, but when it becomes clear that the result is not immediately obtainable, the participants pass to other activities, following a tacit rule of priorities.

The reason why the Tiger program has unexpectedly crashed remains unknown.

The attention to the topic gradually decreases, as does the composition of the group, and at a certain point the problem seems to "dissolve" rather than being "solved."

The second phase of the diagnostic process is more analytical and detailed than the previous one. Exploration of the site and certain applications (particularly the Tiger program) is followed by a joint account of the event which analyses the causes of the problem. This part of the diagnosis also yields results from a technical point of view: the designers understand the nature of the problem better (the Tiger program has mixed the contents), and they conduct analysis of the causes (dwelling first on the behaviour of Tiger and then on the interaction between the program and the designers). However, they decide not to continue with the diagnosis and the subsequent repair, considering that the problem may not happen again, and that the time devoted to this activity would be excessive.

4. What shapes the diagnostic activity?

a) *Time pressure (what kind of time is it?).*

The entire diagnostic process is organized on the basis of a tacit estimate of the appropriate amount of time to be used in every phase, which the designers share as part of their shared professional expertise. As shown also in other studies, engineers always interrelate their actions within an organizational context, and thus organize the coordination of their technological work (Button and Sharrock 1998). Any technical problem solving is an organizational business (Boden 1994; March, 1991), which therefore "invoke horizons of tractability, containing candidate answers (seen before) and solutions (used-before-and-seen-to-work)" (Martin et al. 2007:306). Such situated problem solving results in a different rhythm of work, which takes in consideration the users, the available resources, as well as any consequences.

In the first phase, the repair-diagnostic process, even if effective, is halted because it seems to require too much time, and it is replaced by a more rapid alternative solution. The designers evidently consider the time spent since the beginning of the emergency (around 6 min) as excessive. They know in fact that the time passing is

'heavy' time during which a non-functioning site is visible to all users. It is the impact on the end users and the consequences for the website in terms of traffic that make this situation an emergency, and this part of the diagnosis very rapid.

Time continues to be an important element in the second part of the process as well. The pace of this part of the diagnosis is slower because of a different sense of what time is passing. In the emergency phase, the time required for the diagnosis was implicitly the time that passed with the damaged site visible to the users; afterwards the time of the diagnosis is the engineers' work time taken from other design activities. Although the pressure is not that of the emergency, the designers decide anyway not to solve the problem on the basis of what they think is an appropriate and efficient management of their working time.

These sorts of mundane design decisions are made routinely not only during emergencies but also during more formal development (see in particular Martin et al. 2007 second example for a similar case of discovered-and-unsolved problem), showing how design should be considered as a "praxiological and satisficing concern" (Martin et al. 2007:308), in which at stake is not so much the diagnosis of a problem but the organizational relevancy of solving it.

b) *Flexible roles and distributed responsibility.*

Participation (more active by some, more peripheral by others) is regulated by a tacitly shared awareness of the roles and responsibilities of each actor at that specific work moment (Hutchins 1993). The roles, however, are then renegotiated in order to deal with the emergency more effectively.

The initial phase of the diagnosis is led by Paolo, head of the engineers, who has the task of dealing with emergencies to protect the continuity of the other engineers' design activities.

When, however, it is evident that Paolo is taking too much time, Luca, head of the producers, intervenes with another solution and takes charge of the process: whilst Paolo implements the solution found by Luca, he continues with the diagnosis. Around Paolo and Luca there is a mixed group of producer and engineers (around 5/7 people) who comment and make suggestions for the diagnosis. Once the 'apparent' solution has been selected, the group gradually decreases, signalling that the emergency has ended and they can return to their work.

From here on leadership of the process tacitly passes to Bruno, who has the skills necessary for technical analysis of the Tiger program's functioning. In this second phase, Bruno, Luca and Paolo discuss matters for around 10 min until the group breaks up and the diagnosis finishes.

Team diagnosis enables the pooling of the different professional skills and competences of each participant, yielding better performance and, at the same time, increasing the repertoire of common knowledge, which will also facilitate future diagnostic interventions.

More generally, we can observe how "teams" (or other organizational structures) are resources deployed by social actors (Latour 2005) and how there

is a reflexive relationship between participation frameworks and the ongoing diagnostic practices (Goodwin and Goodwin 2003).

c) *Embodied participation.*

Being in an open space gives easy access to the activities of colleagues. In this case everyone can hear Carlo's announcement ("the site is down!") and see the group of colleagues that hastens to help with the diagnosis.

Other than on talk, motion and opportunistic use of infrastructure, coordination is also based on body signals and cooperative postures (Goodwin 2007). Within the open space office, a leaning bodily posture towards a computer is indicative of full involvement in the ongoing activity. It is a publicly visible clue used by the participants themselves to regulate their participation (and non-participation) in collective activities (Heath et al. 2002).

In this case, too, the designers use this embodied participation framework to join and leave the group working on the diagnosis, as we see when Luca announces his exit by moving his body away from the computer (see extract 8).

Extract 8

Paolo: or maybe (.) we can first see ()

Embodied skills allow designers to organize their bodies in concert with each other in a way that shows their cooperative orientation, and that allows a rapid

joint performance (see Martinet al. 2007 for other examples of cooperative postures among programmers).

d) *Absent participants.*

In the case of a mediated activity like the one analysed here, also 'backstage' participants (the users and the Tiger program) contribute to shaping the diagnostic activities.

In the second part of the episode the Tiger program changes from being transparent tool constantly used by all the designers to place content on the site into an 'actant' (Lee and Brown 1994), not so much because of its autonomy of action, but because it interrupts the work routine of the designers. The agency of the program resides not so much in its mixing of the site's contents as in the effects that it produces on the diagnosis activities of the designers.

In the first part of the episode the pace of the work and the definition of the situation as an emergency depend on a multiplicity of actors physically absent—the users—but nevertheless able to mobilize the immediate and rapid reaction of the designers.

This result underlines how the users are constantly a "contextual feature" in designers' work: they are relevant to the understanding of the situation and to any technical decision, also when they do not explicitly emerge in the discussion (Martin et al. 2007).

The designers in fact tacitly share as part of their expertise the awareness that a certain number of users (around 10,000) are visiting the site during the accident, and it is therefore their accessibility to the site and the visibility to them of the problem that worries the designers. The first phase of the diagnosis is in fact organized to answer these questions: How can we hide the problem from the users? What can we do so that that they won't notice the accident?

The limited access that designers have to those who we can consider somehow 'participants' in the diagnostic activity (the users and the program) makes their practices similar to other work activities whose objects are not visible (as in the case of physicists, neuroscientists, archaeologists, chemists, architects, etc.; see Ochs et al. 1996; Lynch 1985; Goodwin 1994, 1997; Murphy 2004). It is through collaboration in the diagnostic process that designers try to "outthink" the user and the program (Sharrock and Button 1997) so that they can plan their current and future collective activity (see on this point Alby and Zucchermaglio 2007, 2008).

e) *Narratives as specialized discourses for diagnosing.*

Collaboration supports the narrative and interpretative process necessary to make sense of the problem (Orr 1996). Talk in interaction is both the main way in which diagnosis gets done and also the way in which diagnostic experience is incorporating into the community expertise.

Diagnosis took place in particular through a) "trialogues" (Suchman 2002), triangular interactions which involve the technological interfaces in which web

designers give voice to their interpretations of how the technology was functioning (see for example extract 3: "if I access without Tiger the page isn't broken"); b) "rewindings" (Fasulo and Zucchermaglio 2008), collective and detailed reconstructions of the previous phases of the diagnostic process (see for example the joint account by Bruno and Paolo in extract 7).

Considering diagnostic activities (for instance the analysis of symptoms, the formulation and testing of hypotheses on the causes of the problem) as narrative activities allows one to take account of the distribution of such activities in the social and material environment, of the situatedness of the sequence of the diagnostic tasks and the solutions found, and of the specific forms of participation by the web designers in such activities.

5. Conclusions

The analysis of the troubleshooting episode has confirmed that it is necessary to go beyond the technical dimension of diagnostic work to encompass social and organizational aspects as well.

As shown by other cases (see par. 1), the solutions proposed and implemented are not always those that are technically best in abstract, but rather those which are more consistent with other organizational practices and objectives. Initially, in fact, at Energy the superficial diagnosis and the fake solution made it possible to find an organizationally effective solution to the priority problem of immediately showing a presentable site to the users. Also in the second phase of the diagnosis, the technical problem was not solved and the diagnosis was not completed. Between the two possible causes (Tiger or the designer), the group chose to explore the one that cost them less time and energy, so that they could devote themselves to other activities. Hence, within the framework of Energy's organizational priorities, this solution was satisfactory because it took account of the various organizational exigencies.

Consequently, we have seen designers using knowledge that involves a lot more than strictly programming (see also Sharrock and Button 1997; Mackenzie and Monk 2004). Among these competences, for example, were optimizing the workload, knowing how to estimate and save time, distributing energies and responsibilities, gauging the impact of the problem on the users, knowing the roles, competences and responsibilities pertaining to oneself and to others in the solution of the problem.

These competences, obviously together with the technical ones, are also distributed among designers. This is one of the reasons why diagnosis is not an individual undertaking but is realized through forms of collaboration. The group of designers at Energy, for instance, had different but overlapping competences and bodies of knowledge which enabled them to understand, coordinate and organize their participation in the diagnosis, deploying the competences best suited to the problem at hand (Dunbar 1995). Collaboration was therefore

sustained by a particular distribution of competences (Hutchins 1993) and it was performed efficiently precisely because the designers could count on a shared repertoire but also on diversified areas of specialization.

Collaboration enabled the designers to perform the diagnostic activities intersubjectively and discursively: comparing interpretations of the symptoms, discussing different solution strategies, distributing the diagnostic tasks, and using provisional diagnostic results for joint and further exploration of the problem and for future orienting interventions, and so on.

Another difference with respect to traditional models is that diagnostic activities follow a situated rather than abstract rationality (Scribner 1986; Resnick 1987; Lave 1988; Suchman 1987): the process does not consist in a linear and organized pathway from the problem to one 'right' solution; rather, it is a process interwined with material interventions in the system and which proceed by gradual, flexible, and at times recursive, approximations. And it does not always give rise to a definitive or rigorous solution (as also in Martin et al. 2007; Martin and Rooksby 2006).

More in general, these findings on the situated rationality of diagnostic practices are consistent with results on how people take decisions in organizational, ill-defined settings (Lipshitz et al. 2006), findings which are observable only if we study diagnosis as a collaborative activity embedded in local work practices, rather than an abstract topic of cognitive investigation.

Note

1. The participants' and the company's names have been changed, although they agreed to the use of research data for any scientific purpose.
2. The use of the term "broken" (as the Italian "rotta") for a page indicates that designers are constantly aware of the programs that are "behind" the website's pages and make them active and functioning.

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