Monitoring road safety in an information-wired environment: the case of Piedmont

Suivi de la sécurité routière dans un environnement d’information connectée: le cas du Piémont

Sylvie Occelli

Electronic version
URL: http://netcom.revues.org/988
DOI: 10.4000/netcom.988
ISSN: 2431-210X

Printed version
Date of publication: 30 octobre 2012
Number of pages: 201-220
ISSN: 0987-6014

Electronic reference

The text is a facsimile of the print edition.
MONITORING ROAD SAFETY
IN AN INFORMATION-WIRED ENVIRONMENT:
THE CASE OF PIEDMONT

SUIVI DE LA SECURITE ROUTIERE DANS UN
ENVIRONNEMENT D’INFORMATION CONNECTEE: LE CAS
DU PIEMONT

Occelli Sylvie

Abstract — Today, Information and Communication Technologies (ICTs) are an essential
determinant of urban change. They make it possible to build new Socio-Technical Systems (STS)
where the knowledge flow initiated by the interactions of ICT-enabled nodes has a crucial role. This
contribution illustrates examples of these systems. Reference is made to the Piedmont Region, where a
socio-technical system had to be established in order to support the monitoring of the regional road
safety policy. The contribution is divided into two main parts. First, insights for developing the STS
are given and an overview of the road safety planning issues in Piedmont is presented; there then fol-
lows a description of the STS and an account of its regional application and installation.

Key-words — Information-wired environment, Socio-Technical System, road safety moni-
toring, social complexity, knowledge sharing

Résumé — Aujourd’hui les technologies de l’information et de la communication (TIC)
sont un déterminant essentiel pour les transformations des territoires. Elles permettent de construire de
nouveaux Systèmes Socio Techniques (STS) où le flux des connaissances engendrées grâce aux TIC
ont un rôle crucial. Dans cette contribution, un exemple de ces systèmes est illustré. Il fait référence à
la région Piémont, où un système socio technique a été mis en place pour assurer le suivi de la politique
régionale en matière de sécurité routière. Le texte est articulé en deux parties. Tout d’abord, on pré-
sente un aperçu des questions de planification de la sécurité routière dans la région Piémont. Ensuite,
une description théorique du STS est offerte et son application à la mise en place d’un système
d’information pour la sécurité routière décrite.

Mots clés — Environnement câblé d’information, système socio technique, surveillance de
la sécurité routière, complexité sociale, partage des connaissances

1 IRES - Istituto di Ricerche Economico Sociali del Piemonte, Via Nizza 18, 10125 Turin,
Italy. Tel. 0039 011 6666462 - e-mail: occelli@ires.piemonte.it.
INTRODUCTION

Among the policy areas that should inform ICT policy and the information society in Europe over the next five to ten years (SCF Associated Ltd, 2009), the one related to so-called ‘soft infrastructure’ is central to the arguments dealt with in this paper. It concerns those institutions and services that produce the bundle of intangible assets which make up the social and human capital so important in fueling the socio-economic resources of an area. In particular the study emphasizes that as a result of Information and Communication Technology (ICT) progress, the ‘soft infrastructure’ is at a point of transformation. Although in the afore-mentioned study the notion of ‘soft infrastructure’ primarily refers to certain services - such as health, education and emergency services - because of ICT-enabled functioning this component turns out to be increasingly important in the current changes in many other human organizations.

Today, advances in ICTs, notably the increasing spread of web 2.0 Internet-based services and mobile computing, make available an increasingly information-rich environment where new types of socio-technical systems can develop and more resilient ‘soft infrastructure’ can be established (Occelli, 2012). Originally introduced in the fifties, the concept of the Socio-Technical System (STS) has been progressively refined since then, as computing and human requirements have evolved (Castells, 2004, Withworth and Ahmad, 2013). Notwithstanding a number of nuances which have been attached to the STS notions already existing in literature, they all share a common idea. A socio-technical system is a comprehensive entity encompassing human and technological elements, communicating and interacting (sometimes in non-linear ways) by means of manifold social and technical networks. Although no supremacy is claimed by one type of network in shaping the resulting socio-technical system, each one plays a role as, ultimately, they must close the gap between social needs and technical performance, between what communities want and what the technology does (Withworth, 2009).

Designing and developing STS is raising challenging research and policy issues as it is realized that some of their properties, notably openness, learning and resilience, allow them to cope better with environmental complexity, innovative behaviour, new technology, and organizational transformations.

In this contribution, an STS case study is presented. To improve the regional functionality of delivering road accident information in Piedmont, an STS has been created; its main purpose is to reinforce the capability/synergy of the agents’ network involved in collecting road accident data.

The paper examines the regional STS project from its inception to its implementation. An effort is made to show how the STS, initially conceived at the design stage as a conceptual construct, has been progressively updated (and refined) on a practical basis as the different agents have engaged with the STS socio-technical network.
In the next section, insights into the development the STS are provided and an overview of the road safety planning issues in Piedmont is presented. Then, the regional STS experience is described, making reference to a multi-level framework dealing with broadband access, ICT users, ICT application, and systemic learning. Finally, some comments are put forward which raise challenging issues for future research.

1. ROAD SAFETY PLANNING ACTIVITIES AND REQUIREMENTS FOR AN STS

1.1 An overview of road safety planning in Piedmont

Road safety is a societal issue that on phenomenological grounds bears several marks of complexity, i.e. it is under the responsibility of different organizations and entails changes and commitment by both individual citizens and collective agents (see Glasser, 1998). Recently, road safety issues have been a central topic in several planning documents by the European Commission (2010, 2011), the United Nations (ONU, 2010), and the World Health Organization (WHO, 2013).

This general understanding is at the root of the planning activities undertaken in Piedmont over the last decade. A brief overview of them follows which emphasizes, on the one hand their procedural requirements (i.e. those associated with the institutional and administrative features), and on the other, the knowledge needs raised by the planning activities themselves (and primarily those related to the monitoring and evaluation of the road safety policy actions). In fact, to bridge the gaps (or improve the connections) between procedural planning requirements and knowledge needs for managing road safety is ultimately the main purpose of the STS.

The Piedmont Regional Government enacted one of the Action Plans of the Regional Transportation Plan, the Road Safety Regional Plan (RSRP) in 2007. This built upon the 2001 EU recommendations for reducing fatalities and promoting a greater awareness about road safety issues; it also shared the guidelines set by the 2002 Road Safety National Plan, which emphasized the need to co-ordinate the various stakeholders involved in managing road safety2.

---

2 Road safety has been a principal concern of Piedmont transportation policy in the last decade. Before the enactment of the Regional Road Safety Plan (RRSP) in 2007, which provides an overall framework for the regional initiatives, a number of infrastructural programs were carried out in order to comply with the National Road Safety Plan. To strengthen governance, a Road Safety Working Party involving all the stakeholders was also established, and a protocol of institutional cooperation for road safety signed in 2007 by Regione Piemonte, Provinces and the main Municipalities. All these activities stem from the legislative efforts the European and Italian governments have made since 2002 to set up effective countermeasures to road fatalities. Since 2003, they have also turned out be a primary responsibility for regional govern-
The RSRP identifies three main action domains dealing with specific road safety components, namely infrastructure, human behavior, and vehicles. Two additional domains for the management and governance of those components are also defined. Within the management domain the Regional Monitoring Centre for road safety (RMC) has been established. Its main tasks are: i) building the regional road accident data-base according to the official requirements set by the Italian National Bureau of Statistics, ii) supporting road safety initiatives, iii) monitoring (and evaluating) the policy actions, and iv) providing road safety information for the general public.

Each action domain has a tree-like structure, consisting of a number of programs specifying the relevant actions to be implemented. The overall field of actions of the RSRP extends over a medium-long time horizon (10 years). As road safety is a shared responsibility among the different system stakeholders, the regional plan involves all the transportation departments and institutional bodies concerned with road safety at regional, provincial and municipal levels (Fig.1).

Figure 1 - Contents of the Road Safety Regional Plan

ments, as regions have become the owners of the road infrastructures in their territory, with the exception of a few roads at national and international level.
To implement each strategic project, operational programs are defined every year, specifying the type of actions, the eligible recipients, the available funding and the procedures for accessing the financial resources. Depending on the institutional competencies of the various stakeholders involved, three further fields of action are identified: a) supportive actions, aimed at accompanying road safety initiatives carried out by local governments; b) direct actions, undertaken by the regional government itself, as these may require inter-institutional coordination among regional departments and c) normative actions meant to improve the rules for road safety.

1.2 A complexity view of the RSRP

The Road Safety Regional Plan (RSRP) is a coordinated set of future actions formulated by the regional government to comply with the overarching European goal of reducing road fatalities, while providing a reference framework for the actions of governmental bodies, meant to increase road safety. It includes elements of both a programme (as this relates to intentions for future action when certain expected situations arise) and of a policy (a set of future intentions concerning certain categories of situation.)

If we abstract from its institutional role, the RSRP can be considered as a purposefully oriented design, to be leveraged by a coordinated set of agents forming a Complex Adaptive System\(^3\) (CAS) in order to enhance their sustainability (as they reduce road fatalities and strengthen their safety capability) (Boero et al., 2009). In this interpretation, therefore, the plan is also a means by which the system actively constructs the knowledge necessary to inform itself and its own actions.

The scheme in Fig. 2 provides a functional overview of the plan organization in terms of the guiding and operating components of the road safety CAS system. It builds upon a concept of cybernetic control, according to which, for the agents operating in the system, there is a feedback loop between information-action-perception and representations (Donnadieu and Karksi, 2004, Lemoigne, 1999).

Here, the guiding component is understood to be that part of CAS consisting of the agents responsible for actions together with the knowledge capability these agents are able to instantiate as a result of their representations and information. The operating component represents that part of system entitled to deploy the agents’ actions and whose outcome is observed by agents through perception.

---

\(^3\) Human organizations are complex adaptive systems. Three main features distinguish them from other complex living systems. First, they not only build and update models to react to the surrounding environment, but they also construct models for thinking about the world and acting within it. Second, they can deliberately modify themselves and their environment. Third, to maintain their social, economic and environmental sustainability, they can purposefully inscribe into their own organizations and the environment their thinking models in order to pass on the acquired knowledge to future generations (see Landini and Occelli, 2010).
The scheme also emphasizes that as the RSRP is primarily an action plan, its main focus is on the operating component. In this respect, it is evident that as the plan is progressively realized over time the state of the system is changed (and particularly, the number of road crashes and fatalities is reduced) and the hosting environment is affected as well. In particular, Figure 2 points out that the organizational and behavioural transformations brought about by planning are likely to be accompanied by modifications in the reflexive-reflective capability which informs the guiding component responsible for those transformations.

Better aligning the two types of change is therefore important for supporting the plan’s actions over time and improving their effectiveness.

Figure 3 provides insights into the plan’s operating component. Three main blocks are identified and relate to: a) the type of actions to be carried out in order to achieve the plan’s goals and specific targets; b) the results the plan is expected to produce as these are perceived (observed) by the agents; and c) the learning mechanism accompanying the plan’s operations in order to assess their outcome as actions are progressively put in practice. The latter makes explicit how monitoring is an intrinsic component in plan implementation.
2. DEVELOPING THE STS FOR MONITORING ROAD SAFETY IN PIEDMONT

2.1. Premises: an environment on the move

As emphasized in the above discussion, to monitor the RSRP actions reliable and timely road accident data is necessary (see Elvik, 2012).

In Italy, the delivery of this data normally entails three steps. First it is collected by the different police departments on a yearly basis; then it is sent to the National Bureau of Statistics where it is checked, processed and organized into a national database; finally, about 10-11 months after the completion of the data-gathering, it is given to the public and made available to governmental bodies with planning responsibilities. Time delays in delivery and the poor quality of some data are limiting factors which often prohibit the use of the collected information in devising suitable road safety initiatives at the local level.
Taking advantage of the funding opportunities provided by the National Road Safety Plan, in 2007 the Piedmont Transportation Department established the Regional Monitoring Centre for road safety (RMC) with the assignment of setting up a Socio Technical System for managing the Road Safety information system (STS-RS).

The scheme in Fig.4 shows the main agents belonging to the social and technological networks of the STS-RS. More specifically, the social network consists of:

a) police departments, operating at municipal and national levels, who have the responsibility of gathering the data from road crashes occurring on the Piedmont roads;

b) the local monitoring centers supervising data-gathering activities at a sub-regional level;

c) the regional consortium of information systems (CSI-Piemonte) which sees to the development of web data-entry software, manages the regional data-base and provides IT user assistance;

d) the RMC, whose main task is to support the STS-RS while fulfilling its institutional duties (see 1.1).

Figure 4 - The social and technological networks forming the STS for Road Safety monitoring in Piedmont

Three additional categories of agents have a primary interest in STS-RS activities since they can benefit from having reliable and timely information about road crashes, notably: a) governmental bodies who have a direct responsibility for road safety initiatives and law enforcement (such as the regional Health and Police Departments); b) the National Bureau of Statistics and c) the general public.

The STS-RS technological network exploits the broadband infrastructure recently deployed by the Piedmont regional government to boost regional competitive-
ness (see Wi-Pie.org) and in fact, the whole design of the STS-RS would not have been possible without that infrastructure.

Among the main nodes of the technological network are the web-data entry, the regional data warehouse and the regional web-site on road safety, managed by the RMC, providing access to statistical data, regional documents and best practices concerning road safety (see 2.2).

2.2 The layers of the STS

The development of the STS-RS takes its inspiration from a conceptual framework which posits that an information-wired environment results from the deployment of an innovation kernel, i.e. a systemic entity made up of ICTs, information and functionalities operated upon by agents with reflexive and reflective capabilities (Occelli, 2008).

The four constructs which make up the framework serve as a basis for identifying the main descriptive strata worth considering when understanding how STS-RS has been set up. They are re-formulated here as broadband access, ICT users, ICT application, and systemic learning and are briefly illustrated as follows.

Broadband access (ICT networks). As already mentioned, broadband access is a pre-requisite for STS implementation. Since the broadband action plan (Wi-Pie Program) came to completion in 2009, access to wired broadband services with a nominal minimum bandwidth of 2Mbps has been provided throughout the region. The programme has also stimulated the development of wireless broadband services (WI-FI and UMTS) and by 2010, almost all the Piedmont municipalities (93%) had a WI-FI operator and more than 40% have three or more (PICTO, 2012).

The plan also oversaw the implementation of the regional Internet Exchange (TOP-IX), providing access to the European Internet backbone, (see Fig.5.) In 2010, the Piedmont node ranks second in Italy for traffic level.
Broadband connection among firms is as high as 84% and the percentage has been stable over the last couple of years although an increase occurred for faster connections: by 2010, 60% of firms have 2Mbps connections and only 5% have a connection as fast as 20Mbps. In addition, 15% of firms report that available connection speeds do not correspond to those subscribed.

According to PICTO data, in 2010 67% of Piedmont households have Internet broadband access at home.

The map in Fig. 6 shows the level of broadband take-up by households in the European Region in 2010. It suggests that Piedmont is situated on an ideal borderline separating the more advanced Northern regions from lagging behind Southern areas. This gives support to the claim that, at least as far as broadband and Internet availability is concerned, progress in Piedmont since 2005 has occurred at a relatively steady pace.
Figure 6 - Households with broadband connection in European Regions, 2010

Source: EUROSTAT. For the Piedmont region the source is PICTO ICT users. Also as a result of the regional broadband action plan, ICT adoption in Piedmont has increased significantly over the last few years (see PICTO, 2012). At the time of the project inception in 2007, 37% of households and 85% of businesses had a broadband connection. 72% of the Piedmont municipalities had an official web site (in 2010, the value was 88%). In early 2011, broadband uptake has grown to 67% for households and to 91% for firms. Although in 2007 ICT usages were modest compared with those observed in other European countries, their spread was wide enough to raise awareness of ICT potential among the general public. This was an important factor in prompting the decision to invest a significant amount of money in the web data-entry software application.

ICT systems. Software for entering the accident data through the web has been specially implemented (TWIST, Trasmissione Web Incidenti STradali), Fig.7a. As shown in Fig.7b, it is the core component of the road-safety information data-base the Piedmont Regional Transportation Department is progressively building up. Although its content is based upon a questionnaire prepared by the National Bureau of Statistics, its migration from a paper support to a web layout had to be tailored to the needs of the police departments. In addition, a number of functionalities had to be imple-
mented for supervising the communication flows between the police departments, the province monitoring centres and the RMC. Inspired by web 2.0 logic, its development has been a source of social affordances in establishing the whole STS-RS. It gave opportunities for engaging the various agents, thus laying the basis of the STS’s own identity. It also mobilized agents to share their knowledge and experience about data collection and retrieval from road crashes. The meetings and contacts, which took place among the various parties to support the design and test of the data web-entry application, were also helpful for improving its acceptability among policemen.

Figure 7 - The Piedmont road safety information system

7a - The TWIST software application
The overall organization of the information system

Systemic learning. A central notion underlying the whole STS-RS project is that road safety is a shared responsibility among the various agents involved in the Regional Road Safety Plan. This has been a main concern of the RMC’s activities since its establishment. Supporting the learning process for the STS-RS is in fact a top priority for RMC. In this regard, a number of activities have been undertaken, namely:

- disseminating through the RMC’s web-site the collected information concerning road crashes in the region, as well as making available the policy related documents (see www.sicurezzastradalepiemonte.it);
- supporting policemen in their road crash data-gathering activities, in collaboration with the help-desk service delivered by CSI-Piemonte;
- providing training courses for using the web data-entry application (TWIST) and interpreting the road crash indicators;
- carrying out studies about the regional situation in order to get deeper insights into road safety phenomena and their management;
• monitoring the developmental stage of the Road Safety Regional Program (see 1.1).

2.3 Putting the STS-RS into action

As shown in Fig. 4, the Regional Monitoring Centre (RMC) plays a central role in the current STS-RS organization. It has the function of what has been called a ‘supreme unit’ within the overall network configuration (Mesarovic, Macko and Takahara, 1970), because it has priority of action (or right of intervention,) while also depending on the performance of the other units.

Although institutionally-endorsed (see 1.1), RMC’s effectiveness relies on the agents’ commitment to engage in the STS-RS activities. A great effort was made by the RMC to facilitate the engagement process and help the social and technological networks co-evolve as the STS-RS was progressively set up (Boero et al., 2010a and 2010b). The adopted strategy has been informed by a need to apply what some authors have called a ‘socio-technical integration pattern’, to indicate a developmental path capable of enrolling both stakeholders and technology in an organizational and flexible way (see Bendik, Nielsen and Munkvold, 2005).

As is apparent from the previous arguments, different types of activities were carried out by the RMC to support the developmental path of the STS-RS. On a conceptual basis, they can be differentiated into two categories, see Fig. 8:

• activities informed by the requirements associated with the different layers of the STS-RS (see 1.2);
• activities which are transversal to the layers. They are meant to favor a shared understanding of road safety issues, and produce a committed engagement by the different road safety stakeholders.
Actually, the latter activities turn out to be the more challenging, as they concern what has been called ‘third-order’ (or hidden) road safety problems (Rumar, 2000), i.e. those which deal with the processes or conditions related to the organization of road safety actions, such as central or distributed responsibilities, decision processes, resource management, co-ordination and management of road safety work. They also concern the awareness of the value and the knowledge of road safety measures among the members of society: decision makers and road safety workers, as well as roads users.

Underlying these problems are, in fact, some facets of “wickedness” (Rittel and Webber, 1973, Conklin, 2006), which call for an improved mutual understanding among the various stakeholders and a more appreciative regional context (Occelli, 2007 and 2009).

The STS-RS became fully operational in January 2009, when the TWIST application was launched. Since then, a number of functional improvements have been made as the software application has been progressively refined. Currently, about 2200 users (more than 600 police departments) have subscribed to TWIST.
CONCLUDING REMARKS

Road safety is a societal issue which, in a Complex Adaptive System, demands an approach capable of leveraging and legitimizing the evolution of both a social system and its behaviours in certain preferred directions. While institutional endorsement is an essential requirement for innovative policy initiatives to take place, it is also apparent that road safety changes and improvements do not simply result from the bureaucratic transposition of norms and regulations.

The ways road safety actions are taken up and put in practice - by a certain multiplicity of agents with their own goals, beliefs and competencies - are decisive process elements for achieving socially desirable policy goals, such as reduction of road fatalities and injuries.

In the case of Piedmont, the establishment of an STS-RS is an example of how social agents and technology, together, create a new kind of (soft) infrastructure, which makes the road safety system functionality more effective.

To some extent, given the current progress of ICTs, this case study can be viewed as an instantiation of a broader societal project in which designing the architecture of online interaction so that it supports social goals (Whitworth, 2009) is a necessary requirement for the success of today’s information society.

From this point of view, it gives a signal, albeit a weak one, that an evolution in conventional policymaking is taking place. It provides evidence that, eventually, information and, more specifically, a shared knowledge base are fundamental for backing policy activity over time.

On a practical basis, the experience gained by the Piedmont STS-RS can be of use in informing other regional contexts having to deal with similar policy issues. In this respect, it can offer some recommendations as suggested in Table 1.
Table 1. A list of requirements for building a regional STS-RS information system

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>R1. Technological requirement</strong></td>
<td></td>
</tr>
<tr>
<td>R1a</td>
<td>Given the current pace of ICT progress, the Road Safety Information System (RSIS) has to be flexible enough to easily accommodate technological upgrading;</td>
</tr>
<tr>
<td>R1b</td>
<td>The RSIS has to be consistent with the other transportation data-bases existing in the regional data warehouse (that means that great attention should be paid to software standards and interoperability);</td>
</tr>
<tr>
<td>R1c</td>
<td>Attention should be paid to software standards, interoperability and communication protocols with the other agents involved in the STS (National Bureau of Statistics);</td>
</tr>
<tr>
<td>R1d</td>
<td>The management cost of the RSIS should be borne by the agent endorsed with the highest responsibility (in the region)</td>
</tr>
<tr>
<td><strong>R2 Social requirements</strong></td>
<td></td>
</tr>
<tr>
<td>R2a</td>
<td>All the stakeholders involved in the collection or use of road accident data in the region have to be engaged in the STS;</td>
</tr>
<tr>
<td>R2b</td>
<td>Access to the RSIS by the agents having direct responsibility for gathering road crash data has to be made as user-friendly as possible and be flexible enough to accommodate different formats for data inter-change</td>
</tr>
<tr>
<td>R2c</td>
<td>Education and training for the agents having direct responsibility for gathering road crash data should be provided on a regular base</td>
</tr>
<tr>
<td><strong>R3 STS requirements</strong></td>
<td></td>
</tr>
<tr>
<td>R3a</td>
<td>Institutional and administrative constraints should be made explicit and all the stakeholders be committed to overcoming them</td>
</tr>
<tr>
<td>R3b</td>
<td>Mutual trust among the stakeholders should be nurtured</td>
</tr>
<tr>
<td>R3c</td>
<td>An appreciative culture for the resulting road safety information system should be created</td>
</tr>
</tbody>
</table>

Notwithstanding the positive outcome, the Piedmont experience also exposes a number of problems which raise challenging issues for future research.

A major barrier encountered in implementing the STS-RS was the passivity manifested by agents having to use the web-data entry (TWIST). Although the software has been in operation for three years by now, few TWIST users are fully aware
of its potentials, such as the advantages stemming from more reliable information, speedier administrative procedures and more reliable design of road infrastructures.

Indeed, this passivity is also apparent in several other governmental bodies in Piedmont (see PICTO, 2012). Although this is a recurrent trait in many human organizations exposed to rapid technological progress, because of the unique features of modern ICTs (notably pervasiveness, synchronicity and inclusiveness,) STS can, in principle, create the conditions to defeat it.

By offering the possibility of enhancing agents’ reflexive (and reflective) capability it creates the opportunity of sharing the design architecture of online interaction in an inclusive way, and of achieving more socially desirable societal outcomes (see Fischer and Herrmann, 2011, Umpleby, 2007).

REFERENCES


---

4 By reflexive ability we mean those distinctive traits allowing humans to make sense of their living experience, such as the capability to derive measures from the external environment and extract knowledge while operating as observers (Occelli, 2007).


