Inquiry In Control Rooms – An Analysis Through The Lenses of Space, Time and Practice

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ABSTRACT

In recent risk studies, some researchers have raised concerns regarding the focus on extraordinary events - sometimes called "extreme paradigm" (Gaillard, 2007). Simultaneously, we are witnessing a growing interest in the more "ordinary" situations that must be handled on a daily basis in order to avoid crises (Roux-Dufort 2007, Van Laere 2013). In an interdisciplinary perspective of sociology and geography, we have analysed five different control rooms (traffic safety, air traffic control, humanitarian coordination, weather forecasting and electrical supply). This transversal perspective has helped us consider control rooms as specific spatio-temporal devices, where ordinary practices aim as much at crisis avoidance as at crisis management. We conclude that it is important to broaden the analytical perspective of control rooms; to no longer regard them as the source of action but rather as one aspect of larger socio-technical monitoring devices.

Keywords

Control rooms, space, time, action, monitoring

1. INTRODUCTION - CONTROL ROOMS: A PLACE OF ORDINARY PRACTICES IN RISK MANAGEMENT

In recent risk studies, some researchers have raised concerns regarding the focus on extraordinary events - sometimes called "extreme paradigm" (Gaillard, 2007). Simultaneously, there is growing interest in the more "ordinary" situations that must be handled on a daily basis in order to avoid crises (Roux-Dufort 2007, Van Laere 2013).

In this respect, control rooms merit specific attention because they are an exemplary case of everyday risk management (Gilbert, 2012), i.e. risk actors' daily routines and activities, which are characterized by discrepancies, constant adjustments and crisis avoidance.

Beyond what specifically takes place in these rooms (notably studied by the Command and Control Studies and the Computer Supported Cooperative Work studies), we will explore their relationship to their environment, and how it shapes the conditions of action in risk management.

Pawlak and Ricci's (2014) work clearly demonstrates the benefits of a transversal reading of control rooms, and implicitly posits that, regardless of their specificities, control rooms function based on a generic model, especially in terms of how information is handled and shared1 (see also Botterell and Griss 2011).

1 We use the term "control room" generically to describe the different variations (crisis rooms, situation rooms, etc.), and to show that crises are but one aspect of the work done in these rooms.

In an interdisciplinary perspective of sociology and geography, we will explore the spatio-temporal dimensions of control rooms, and what they reveal and imply in terms of action in a complex, moving world.

A control room is, by definition, a space whose meaning depends intrinsically on the fact that it is part of a larger space in and on which it is designed to act. However, the actual spatial dimension of control rooms is a blind spot in the literature. In this regard, recent works on the spatiality of risks (Mueller-Mahn 2013, Bickerstaff and Simmons 2009, November 2008) open new analytical perspectives. By considering risk management as an assemblage resulting from the agency of several spatialities that are specific to the various elements involved in a risk situation, we can study how control rooms interact with their environments (the rooms themselves, the networks they are connected to and the spaces they monitor/on which they act). In this respect, control rooms can be seen not only as a central space - or source of action - but as a device2 helping to link several dynamic spatialities that far exceed the space of the room itself. The operator's job is to constantly coordinate these dynamic spatialities.

This article thus attempts to show the importance of considering control rooms as spatio-temporal devices for action that are indicative of contemporary challenges in risk and crisis management. In this regard, we seek to open a dialogue with previous studies from the control and command field that have focused either on the inside of control rooms (Bergstrand 2011 for instance) or outside (*Andresen and XXX 2014*), but not on the relations between the two.

2. CONTROL ROOMS: THEORETICALLY DIVERSE CONFIGURATIONS

Our analysis is based on a survey of five control rooms (semi-structured interviews and observation)3, which allowed us to compare extremely divergent risk management situations, both by function (weather forecasting, highway network, power grid, humanitarian crises management and air traffic control) and room organization (see Table 1).

As Table 1 shows, these rooms manage different types of risks and monitor different objects using a number of technical and human resources. Their areas of intervention vary considerably, both spatially and temporally.

Nevertheless, the work's transversal perspective helps us understand control rooms as specific spatio-temporal devices, where ordinary practices aim as much as at crisis avoidance as at crisis management.

	CASTOR	OCHA	Skyguide	MétéoSuisse	Alpiq
Function	Traffic safety	Humanitarian coordination	Air traffic control	Weather forecasting	Electricity production and distribution
Organization	Canton of Geneva, Police	United Nations	Switzerland	Switzerland	Private Swiss company
Room name	Centre for monitoring and intervention (CSI)	Emergency Relief Coordination Centre (ERCC)	Area Control Centre (ACC)	Regional weather forecasting centre	Operation and management centre (CEG)
Objects monitored	Geneva highway bypass + several urban tunnels	Major emergencies in the world	Air traffic	Weather phenomena	Electrical network
Spatial scale	27-km. Network + urban tunnels (2D)	The world (2D)	E-W air lanes: Bern–Lyon (300km) N-S: Vesoul–Gap (450 km)	Switzerland, with a focus on the French-speaking Cantons (3D)	French-speaking Cantons of Switzerland network (2D)

2 Device here is used to express the French word "*dispositif*," which includes the social, technical, political, organisational dimensions of an entity.

3 The material gathered in the first phase led to the production of a scientific documentary.

			ENE-SSW: Dijon–Lyon (450 km) (3D)		
Hours of operation	24/7	Need basis	24/7	24/7	24/7
Technical means for action (alert, coordinate relief, etc.)	200 cameras; fire and smoke sensors, automatic incident detection	GDACS (Global Disaster Alert and Coordination system) + online platform called Virtual OSOCC (On-Site Operations Coordination Centre)	Flight plan management tools; software for calculating distances between planes	Deterministic or ensemble (probabilistic) numeric models; Small- and large scale models	The SCADA system produces visual and sound alarms ; numerical model for forecasting storms
Manpower	15 operators, work in pairs	Operation Task Force is a 6-7 person group called upon depending on the nature of the disaster	2 air traffic controllers per air space (depending on traffic density)	1-4 forecasters	14 dispatchers
Possibility of information feedback from users	Yes, by phone	Indirectly (social networks)	No	Yes, by phone	No

Table 1. Characteristics of the Five Control Rooms

3. CONTROL ROOMS: SHARED SPATIO-TEMPORAL DEVICES FOR ACTION

The different rooms and activities that are carried out in them have several points in common.

First, it appears that, regardless of the nature of the activity, control room operators' work involves monitoring a "risk area" (motorway bypass, planes in the sky, an electric network, etc.) outside of and separate from the room itself.

The risk areas monitored have three points in common:

1) they are too big and too distant to be monitored without tools (cameras, sensors, etc.) and, more importantly, without a specific spatial working organization.

2) they are dynamic: the objects monitored (highways, air traffic, the movement of electricity, atmospheric changes and humanitarian operations) are in continuous flux and have unpredictable rhythms. Constant monitoring is needed, even though "nothing may happen" for long periods of time.

3) they are connected to control rooms with devices that allow the monitoring of large objects (highways, airspace, etc.), while distancing those in charge of managing it from the risk itself.

To manage this spatial and temporal challenge - all the more critical when lives are at stake - operators have a number of more or less complex tools: telephones (essential!), cameras, radars, modeling software, etc. However, as we shall see, they also use less "technical" resources, such as experience and discussions with colleagues. Control rooms are spatio-temporal devices designed to better link these resources and their

spatialities so that action may be taken.

The multi-room approach allowed us to better identify the spatio-temporal dimensions that underpin the existence and organization of control rooms. The latter are a specific type of spatio-temporal device that allow for action in a world that is both too big and too dynamic for classic techniques.

Five key elements characterize control rooms as spatio-temporal devices.

3.1. Extending actors' senses to make spaces more "graspable"

"Without the cameras, we're more than blind." [CASTOR]

A portion of the tools found in all the rooms we visited (cameras and other sensors) were designed to "extend" the senses of operators, who can thus be "present" at events at various points in space in virtually real time. In this regard, the CASTOR room is exemplary. Thanks notably to cameras, operators can visually monitor 27 kilometers of motorway simultaneously, and without moving.

But this "seeing" does not inherently necessitate a live image: some instruments are used to "visualize" information that has already been codified. For example, in air traffic control, planes are represented as diamonds on the radar: one does not "see" the plane itself, but rather sees what matters: its absolute position and position relative to other aircraft, its direction and its speed.

Using a variety of techniques, these rooms reconstruct an external and distant reality in order to observe it from a better angle. They therefore do not observe it via physical presence, but by scaling down what is happening in a larger space (i.e. the sky) to the dimensions of screens in a control room (Latour 1985).

These tools, combined with expertise and experience, enable operators to be constantly present in a large (relative to what can be seen without them) and spread out world, at little cost.

3.2. Allows for a step back from the field to see the whole picture

"If I have to make a difficult decision like establishing aid priorities between one village or another, I have distance and I need it." [OCHA]

Because they monitor far-away spaces, operators have a somewhat distant relationship to the individuals actually on site. This is a key condition of their effectiveness. As one air traffic controller put it, "We don't see the passengers. On our screens, planes are represented as green diamonds." This is important; operators could not handle air traffic while thinking about each person on each plane. In other words, operators must detach themselves from the "details" in order to ensure overall performance and the safety of many.

However, operators are not always able to "divest", and are far from being deaf to the reality in the field; more or less formal information also flows back (e.g. testimony from a firefighter on the ground that contradicts the weather model). Also, operators sometimes can be emotionally involved with individuals (e.g. when reassuring an injured person who calls the CASTOR center).

Operators' work therefore involves a subtle play of distance from and proximity to the place and individuals whose security they ensure – play that shapes their efficiency and demands constant adjustment.

3.3. Allows for a step back from the emergency time pressure to make decisions based on the information received and to identify risk signs

"If a problem occurs, it's better to do nothing for 10 minutes and think than to jump on the controls and do just anything." [ALPIQ]

The spatial distance between the control room and risk area is coupled by a temporal distance. This allows operators to not be seized by the urgency of the situation and to avoid "tunnel vision", which is all the more necessary given that these tools - be they sensors (cameras, etc.) or analytical systems (e.g. automatic identification of stopped cars with CASTOR) - generate a continuous flow of multiple and heterogeneous information that operators must filter.

Moreover, in this flow, certain information can prove to be false signals. While tools allow operators to detect anomalies, failures and potentially dangerous patterns, they are nonetheless limited because they are based on an

imperfect knowledge of phenomena. Indeed, all the objects monitored in the rooms we visited exhibit somewhat chaotic behavior (in terms of probability), and therefore are unpredictable.

One of the major challenges for operators is sorting and assessing the validity of the information they receive in order to detect risk signs early and be able to act quickly and efficiently. But these clues are often tenuous, getting lost in the mass of information, and can crop up at any point in a potentially numbing routine. It is therefore essential for operators to set time aside for analysis: all signals do not necessarily indicate a risk and, for now, the filtering and interpretation done by the operators themselves is indispensable. Although time frames differ from one room to another (from a few seconds for air traffic controllers, to a few minutes for ALPIQ, to several hours for MeteoSuisse and OCHA), time for analysis cannot be rushed, as it is a necessity for efficient human-tool complementarity in terms of managing risks.

3.4. Allows for the sharing of interpretations of a given situation to build meaning

"What helps us choose the most important information is our experience, and talking with our colleagues." [MétéoSuisse]

One of the key added values of control rooms is a shared physical space where agents come together. This cohabitation provides them two fundamental resources to compensate for the limitations of their tools: experience and discussion.

With their extensive knowledge of the tools (and their limits) and the objects being monitored, experience allows operators to simultaneously be wary of their tools, to detect irregularities as yet undetected by the machines, and to interpret information in order to determine whether what they see is an indication of risk or an inconsequential and irregular signal. In the words of one meteorologist, "You can't apply a model to a T." Or an ALPIQ operator who said, "Every unexpected situation requires some analysis because there is no ready-made solution...It's no use doing things quickly without thinking, by routine...That comes through the experience of analysis."

Experience takes shape and develops largely through working with colleagues. This collective aspect is essential when analyzing and making decisions in situations of risk: "When you work with someone for a long time, you know how they react and what they're best at. [W]e divide up the work better" (CASTOR). Another example: "[When you follow a situation], it stabilizes over discussions between people…Every time we change shifts, we talk... [G]radually a general idea emerges from the discussions…"(MeteoSuisse).

3.5. Organising daily attention to better link routine and unexpected events

"There's a certain routine, but [there are] still unexpected events; we have constantly changing parameters, and that impacts our work." [SKYGUIDE]

It would be misleading to imagine the work in these rooms as continuous crisis management. On the contrary, on a daily basis, quiet times largely outnumber moments of crisis. What is difficult, in fact, is the "arrhythmia" of the monitored objects: the irregular (and thus unpredictable) alternation of down time - when one must nevertheless remain on standby - and emergencies – when one must be ready to act immediately. Operators cannot at any time "disconnect" from their monitoring and shift into "enacted vigilance" mode (Klauser et al. 2006; Roux 2006).

Most operators describe a certain work routine, while those who do not have one try to develop one, as the coordinator of OCHA's Rapid Response Team describes: "Of course, emergenc[ies] are always unpredictable. [W]hat I try to do is establish a routine so it doesn't become completely chaotic." These routines paradoxically allow them to remain vigilant for their entire shift, turn, or service, and thus act quickly in the event of an emergency.

Moreover, the continuous flow of data means around the clock work for operators. When they arrive at work, they must enter into this flow to start their "watch", i.e. to learn what has happened during their absence, get acquainted with the current situation and start their own monitoring.

This routine/emergency dynamic, punctuated by watch shifts, is a salient aspect of operators' work and one of the key characteristics of good risk surveillance.

4. CONTROL ROOMS: SPATIO-TEMPORAL DEVICES TO FOCUS ATTENTION

Finally, our analysis shows that these rooms are only useful within the larger perspective that includes the space under surveillance, the object being monitored and the tools that link them. Therefore, if we want to understand what is at work in the proliferation of control rooms in contemporary societies, we must not only observe these rooms and their operators, but also follow the tools and practices that connect them to the outside world, and analyse how these relationships are organized and maintained.

Control rooms find their greatest utility in the articulation of spatialities, that may be describe by:

1. A space to monitor and on/in/with which to act, which ideally corresponds to the deployment area of the surveilled object/space (traffic, weather, etc.).

2. A monitoring centre, or control room, characterized by a single space in which specialized operators work, usually isolated from their immediate surroundings. This room is always separated from the monitored space and partially protected from the outside (blind rooms, restricted access, etc.). It is often connected to other players working on the same object/risk area (e.g. intervention patrols).

3. Links between the risk area and control room via technology (sensors, networks and display devices) and practices that make this technology useful (distancing, experience, sharing with colleagues, etc.).

This configuration – i.e. large and/or distant areas monitored remotely by isolated operators - is emblematic in terms of spatiality, and its growing use invites interpretation that joins with previous work (Créton-Cazanave, 2014): control rooms are an aspect of the management of a key issue in the contemporary world, namely emancipation as a condition for action. By emancipation we mean that, in order to be connected and vigilant to the part of the world in question (risk areas in this case) targeted through an intervention, it is necessary - or at least helpful - to temporarily put aside part(s) of reality (i.e. the players' immediate and multi-faceted environment).

5. CONCLUSION

This study highlights not only the spatial and temporal dimensions of control rooms - dimensions that, until now, have not received a great deal of attention from researchers - but also underlines that the basic condition of action in situations of risk and crisis results from emancipation. We conclude that it is important to broaden the analytical perspective of control rooms; to no longer regard them as the source of action but rather as one aspect of larger socio-technical monitoring devices.

This has allowed us to clarify in part how operators in control rooms avoid crises by maintaining assemblages - from the everyday to crises - with specific spatio-temporal devices adapted to a complex and dynamic world. As they help make emancipation (and hence action) possible, control rooms – considered as spatio-temporel devices - respond to widely shared issues in risk management.

Thus, approaching the issue from a spatio-temporal perspective makes it possible to address "crisis management" from a new angle and to highlight basic, everyday (though little studied) practices.

It allows for a new understanding of control rooms, and helps us analyses their purpose: keeping a large and changing world together and avoiding major crises whenever possible. But control rooms and their activities are nearly invisible to the uninitiated, let alone average citizens, who constantly cross these monitored "risk spaces" without even realizing it. Therefore, how to support and value this daily work "in the shadows" that we only talk about when something goes wrong? How to distinguish between the work of "guardians of risk," from which we all benefit, and surveillance practices that – quite rightly - give rise to democratic concerns?

This is the main goal of Euridice (coordinated by the authors of this paper), a research project led in cooperation with the General Secretariat of the Security and Defense Zone of Paris. This project, which began in September 2015 and will last for a period of two years, will undoubtedly provide answers to these fundamental questions.

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