O.W. Bertelsen, L. Ciolfi, M.A. Grasso and G.A. Papadopoulos, (eds.)
ECSCW 2013: Proceedings of the 13th European Conference on Computer Supported Cooperative Work,
21-25 September 2013, Cyprus

Temporality in Planning: The Case of the Allocation of Parking Areas for Aircrafts

Ilaria Redaelli and Antonella Carassa
Università della Svizzera italiana (Lugano, Switzerland)
ilaria.redaelli@usi.ch; antonella.carassa@usi.ch

Abstract. Several recent studies have focused on plans as coordination devices, demonstrating how organisational members use such plans to organise and make sense of their work. This research project aims to foster empirical research on plans showing how operators at the centre of coordination in handling activities at an Italian airport plan the allocation of parking areas for aircrafts. Based on the analysis of the operators' knowledge of the temporal features of planning, this research contributes to the understanding of how timely assistance for aircrafts on the ground depends on how spaces are allocated. This research highlights temporality in planning and promotes the understanding of the features of allocation and planning as situated and distributed activities.

Introduction

The aim of the research

Recent research has identified several features of plans and planning as well as plan failures in the organisation of the temporal order of work activities; however, investigations into how people's experience with the workplace setting's temporal structure might impact the use or setup of plans are lacking. This research project aims to address this issue by studying how the ramp control tower operators of an Italian airport plan the allocation of parking bays for planes. This setting offers the possibility to observe situations and behaviour that embody the topic under study in a perspicuous way (Garfinkel, 2002; p. 182). It is our contention that understanding temporality in planning might foster our understanding of not only the procedures for establishing plans, but also plans as temporal coordination devices. Our study draws on the practice-based perspective of time to contribute to the understanding of the role of temporality in planning as a situated and socially constructed activity (Bardram, 1997).

In order to develop our argument, we first present existing studies that have focused on planning and temporal coordination. We then introduce information about planning in the ramp control tower (RCT) and discuss the temporal features of such activity. Finally, we provide several suggestions for incorporating temporality into the design of software to ensure successful support in planning and coordinating work.

Debating plans in the Computer-Supported Cooperative Work (CSCW) community

The debate on plans in the CSCW community first emerged in the 1980s in response to Suchman's (1987) work criticising the possibility for plans to causally determine actions, as claimed by cognitivist theorists. Suchman demonstrated that actors' actions cannot be conceived as being determined by plans stored in memory in the form of formulated prepositions as actions are never planned in the causal sense, but rather always situated in the circumstances of the specific context. In addition, Suchman's characterisation of plans as weak resources for the control of actions affected subsequent study of the role of plans in work organisations. Schmidt (1999) argued that the development of the "situated action" concept increased scholars' interest in understanding situated actions, albeit to the detriment of the analysis of plans as "guidance for work". Suchman's work has also often been perceived as introducing a sort of opposition between plans and situated actions, presenting plans as poor resources that limit human actions; as a result, they cannot give an account of all the occurrences of situated actions.

Starting in the 1990s, several scholars began criticising some of Suchman's development (Ciborra, 2002; Schmidt, 2011; Vera and Simon, 1993). For example, Schmidt (2011) disentangled some of the conceptual confusion about the "presumed weakness" and "incompleteness" of plans while Bardram (1997) demonstrated the situated nature of planning. Bardram's analysis of the daily clinical work showed that hospital patients' assistance is organised based on an on-going and socially constructed planning activity which is enhanced by and simultaneously shapes the work activities at the hospital. In fact, advanced planning, drawing on standard treatments for diseases, allows for anticipation of ways in which activities are executed while plan implementation allows for the adjustment of the plan to the conditions of the specific situation. Thus, the strength of plans is the anticipation of future ways of performing activities, detached from—but still taking into account—the conditions of the real-world settings.

Situated use of plans

According to Rönkkö et al. (2005), empirical research on plans has thus far focused on two main goals in that scholars have sought to understand not only the relationship between plans and actions, but also how organisational members orient themselves to plans to make sense of their work in contextually specific ways. Several empirical studies have explored how plans are used as artefacts for the coordination of work activities, analysing how plans' relevance is occasioned in the circumstances of their use (Bossen and Markussen, 2010; Button and Sharrock, 1998; Dant and Francis, 1998; Koskinen, 2000; Randall and Rouncefiel, 2011; Rönkkö et al., 2005; Schmidt, 1999).[1] Such research has demonstrated that plans can be used in various ways, such as for the reconstruction of courses of actions (Dant and Francis, 1998) or as "perceptual background" against which to identify troublesome elements or situations (Koskinen, 2000). These studies have also investigated what happens when plans do not work out (Bardram and Hansen, 2010; Rönkkö et al., 2005) and the impact of the medium of schedule for the solution of problems of coordination (Whittaker and Schwarz, 1999).

Temporal coordination and planning

Plans as "valuable mechanisms for giving order to work" (Bardram, 1997; p. 18) are often employed in organisational settings for the temporal coordination of work activities. However, no systematic attempt has been made to link the study of temporality and planning. In the CSCW community, there is growing interest in the role of temporality in the coordination of work activities as more and more scholars have noticed a lack of research focused on temporal coordination compared with spatial coordination, thereby undermining the possibility for software to adequately support cooperative work.

Among the studies exploring temporality for work coordination, studies have examined long-term timeframe coordination (Reddy et al., 2010) as well as short-term timeframe coordination (hours or days), focusing more on temporal coordination within the organisation than within a single team at work (see: Egger and Wagner, 1993; Bardram, 2000; Reddy et al., 2006). Other research, even if not directly addressing the issue of temporal coordination, has shown both the failures of schedules in organising the temporal order of work activities and the

---

1 It is worth noting that this research defines plans as "we might intend this term in ordinary affairs" (Sharrock and Button, 2003)—that is, artefacts that anticipate future ways of performing activities (Bardram, 1997) and that might take the form of "formal organizational constructs" (Schmidt, 1999) such as schedules, office procedures, classification schemes, and checklists.

modality by which plans can be used to achieve the temporal coordination of activities. These studies have shown that schedules might define deadlines inaccurately or in a non-credible or consistent way (Whittaker and Schwarz, 1999) and that particular efforts are necessary for people to meet deadlines. For example, Button and Sharrock (1996) found that the orderliness of work depends on the reflexive relationship between the schedule, which orients work activities, and the way in which such activities are carried out in order to meet the fixed deadlines. Meanwhile, other studies have examined the role of temporal patterns in providing means for the coordination of work (Reddy and Dourish, 2002; Nilsson and Hertzum, 2005). In the study of temporality for the coordination of work activities, an increasing interest is emerging in the practice-based perspective of time (Reddy et al., 2006; Karasti et al., 2010), which was first developed by Orlikowski and Yates (2002), who suggested considering people as "experiencing time through shared temporal structures [that] they enact recurrently in their everyday practices". Thus, people are oriented towards the means that organisations provide for the objective organisation of time (e.g., schedules) while such constraints simultaneously enable different actions so that "temporal structures both shape people's actions and are shaped by such actions" (pp. 686-689).

The study

The empirical materials analysed here belong to a wider corpus of data collected in the course of an ethno-methodologically (EM) informed research (Crabtree et al., 2000; Garfinkel, 1967; Randall et al., 2007) carried out in the coordination centre (Suchman, 1997) handling activities in an Italian airport—namely, the apron tower.[2] The research lasted eight months.

Empirical materials were collected by means of direct observation of the field, interviews with RCT operators and tape recording of naturally occurring conversations. The researchers interviewed RCT operators, drawing on the ethnographic interview technique (Sherman Heyl, 2001), during the plan setup and application phases so to gather information about their decisions regarding the observed activities. The interviews were not structured in advance and were triggered by the occurrence of particular events or situations. During the data-collection phase, the operators were observed for two to three days a week, according to the organisation and duration of their shifts, so as to observe all the activities carried out in the centre, which offers 24-hour service.

The objective of the data collection was the detection and study of the operators' practices in allocating resources during the planning phase. As such, particular attention was devoted to the identification of recurring patterns in the

2 In this paper, the terms "apron tower" and "ramp control tower (RCT)" will be used interchangeably.

plan setup among the operators, following Llewellyn and Spence's (2009) suggestion for conceiving practices as members' phenomenon for the accomplishment of an EM-oriented study of practices. Therefore data collection was not oriented to the mere identification of patterns of activities, but to the study of the details of interactions so as to determine how activities are intersubjectively organised and recognised by operators as embodying (or not) a certain practice.

The EM-oriented study of members' practices is suited for the investigation of how local knowledge is deployed in the execution of everyday work activities as the detailed observation of members' active conduct allows for identifying the link between knowledge and action (Llewellyn, 2008; p. 783). The term "local knowledge" (or local expertise), which refers to Normark and Randall's (2005; see also: Randall et al., 1996) conceptualisation, addresses a corpus of knowledge—mostly informal—that emerges from what people have experienced and whose relevance depends on local circumstances of work. Therefore, local expertise, which includes the knowledge of how to deal with procedures[3] and others' expertise, is necessary for the contingent enactment of organisational requirements and ultimately for the orderly accomplishment of work.

The RCT operators' practices analysed here represent patterns of activities not reported in protocols, but to which the operators are oriented in that they have demonstrated the knowledge that they are expected to follow these practices and justify any deviations with colleagues. In particular, our research focuses on how the local expertise on temporality in planning allows for the management of the contextual conditions of work. It is our contention that it is worth considering not only the temporal structure of practices—that is, "when people do what" for the accomplishment of their work—but also people's local knowledge of how others organise their own activities over time. When people do what they do as well as how much time such activity usually takes also matters.

Extracts reported here come from the ethnographic interviews collected in the course of the study.

The setting of the study

The observed airport has a simple structure (i.e., one runway and one terminal building) and small dimensions, but it is the third most active Italian airport for cargo air transport movements and the fourth largest in terms of the number of annual passengers, which has progressively increased from about 3 million in

[3] The indexicality of rules and instructions has been widely investigated in ethno-methodological studies that have shown that (1) being competent in following instructions means being able to grasp the connection between an outcome and courses of actions based on information given in the instructions (Zimmerman, 1971) and (2) rules and instructions often work as "prospective accounts". Indeed, rules can serve as accounts for what was done, "although in any actual performance a great deal more is necessarily done that can be comprised in the instructions" (Amerine and Bilmes, 1988; pp. 329-331).

2003 to 6.5 million in 2008, which corresponds with the growth of low-cost airlines. The airport is home to a mix of low-cost, charter, and cargo airlines, although low-cost companies represent the majority of the airline companies operating in the airport.

The airport's RCT operators carry out two main activities: the coordination of the execution of handling activities and the setup of the plan for the use of aircrafts' parking areas (i.e., the stands) and gates. RCT operators are responsible for communicating during planes' approaching with the ramp personnel, crews, and air traffic control operators so as to instruct crews about where to stop and ramp personnel about where to converge in order to handle each plane properly,[4] given the duration of the turnaround times defined by each airline company.

RCT operators are also required to ensure that each aircraft on the ground has an appropriate parking area at its disposal for the length of its stay on ground. To this end, RCT operators plan the use of stands twice a day, monitor whether these planned solutions remain useful despite last-minute changes in the number and/or timetable of scheduled flights, and modify the plans as necessary. The plan setup is organised in stages of necessity in that the operators access the necessary information at different times of the day. As a result, the stand allocation plan setup can be defined as a distributed activity as the plan is the result of layers of decisions made by several actors in due time while managing several other activities.

Planning the stand allocation

The stand allocation plan is defined when the operators know the exact number of planes that need to be parked, their dimensions, their arrival and landing time, and how long they will stay on the ground. RCT operators receive such information twice daily from cargo and passenger airlines; the information is shared in the form of "rotation lists". The rotation lists are documents in which each airline company matches aircrafts with the flights to be carried out the next day. This information enables the RCT operators to determine not only the number of planes to be parked and the time of their arrival and departure, but also how flights are assigned to planes. Thus, they can assess how long each plane will stay on the ground (see Figure 1).

4 Handling activities on the ground comprise aircraft fuelling, luggage loading and unloading, and passenger assistance during boarding and disembarkation procedures. The apron tower operators coordinate the activities on the ground by means of both radios and mobiles, with which they are in touch with all the operators on the ramp (ramp agents, bus drivers, marshalers, follow-me truck drivers, etc.).

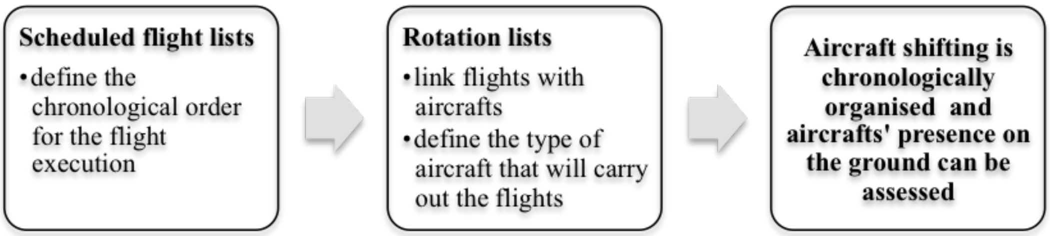

Figure 1. Matching schedules with rotation lists

For the stand allocation plan to be set up, the RCT operators have to consider the number of stands and gates at their disposal as well as the stands' technical features. Stands' features allow their exploitation in different ways so that possibilities and constraints in their use emerge as a consequence of the planning itself. Stands are delineated according to their maximum capacity (which, in turn, is defined on the basis of the length of the fuselage and the wingspan of the biggest aircraft that can be parked there), the manoeuvres allowed to reach and leave them, and the number of parking areas that cannot be used simultaneously (see Figure 2).

Stand number	1	2	3
Capacity	Up to B757	Up to B747	Up to B737
Manoeuvres	Push back	Self-manoeuvring	Push back Self-manoeuvring
Inhibitions	2 3 4	1 3 4	2 4 5

Figure 2. Technical features of stands

Parking areas for aircrafts have different dimensions to appropriately accommodate the various planes, whose sizes vary considerably. Each stand can accommodate different types of aircraft as they can be used to park planes whose size does not exceed the maximum capacity of the stand. It is important to understand the manoeuvres required for each type of plane to leave the stand as different types of aircrafts' manoeuvring requires a different amount of space when moving into and out of the stand. Stands might also overlap exit ways, so their use might be limited during the planes' manoeuvring. Stands are distributed over the ramp and the apron space. The ramp space is the airside area next to the terminal building, while the apron is an area far from the terminal building.

Like stands, not all gates are equal. Gates, which have different features, can be directly connected with stands by means of fixed jet bridges (structures the RCT operators call “fingers”); thus, the use of stands and gates has to match. In other words, once a stand is assigned to a certain flight, the boarding procedures of that flight have to take place at the gate structurally linked to that stand. In addition, whereas some stands allow for passengers’ boarding on foot, others do not, meaning that buses have to be provided for the latter group. RCT operators plan the use of stands and gates while considering flights’ scheduled times. The operators set up the stand allocation plan based on the premise that flights will be carried out as expected according to the schedule, working sequentially on the plan set up.

Although software devoted to the determination of stand allocation is available, RCT operators never use it for the automatic allocation of stands; rather, they use to aid in the manual allocation of stands, exploiting the fact that the software highlights conflicts during the stand allocation. The software presents stands in a Gantt’s chart that allows for the visualisation of stand allocation over time. Operators drag and drop flight numbers on the chart, and icons that represent the length of planes’ stay on the ground appear; a colour code system alerts the operators whenever conflicts in the stand allocation emerge. For example, the alarm colour code would signal a mismatch between the size of the stand and the size of the plane.

Managing time when planning in the RCT

When planning, the RCT operators do more than solve space allocation problems as they not only match stands with planes’ dimensions, but also—by allocating stands and gates—contribute significantly to the coordination of handling activities. The careful exploitation of gates and stands allows for the convergence of passengers, equipment, and personnel when necessary, thereby ensuring the timely execution of handling activities and ultimately maintaining the coordination of the activities necessary for flight execution. Yet to achieve such a result, the RCT operators have to address three main problems connected with temporality: ensuring the stands’ availability over time, monitoring the duration of handling activities, and keeping delays under control.

Ensuring the stands’ availability over time

The objective of planning in the RCT is to ensure the necessary stands are available to accommodate arriving planes for the entire duration of their stop. To achieve such a goal, the RCT operators have to set up the stand and gate allocation plans within fixed deadlines even if they neither receive all the rotation lists simultaneously nor receive them in time to set up the plan. This implies that the RCT operators often have to plan in relatively uncertain conditions. In addition when the RCT operators establish their plans, they never have empty bays to fill as they always have planes on the ground whose allocation was defined by the previous planners

> If three airbuses are going to arrive, I have to put them at 37, 40, and 42, respectively, and this inhibits the use of several stands: 36, 38, and 39. In the evening, 14 Redair planes are going to arrive, then we could have the Blueair and perhaps the Pinkair, so we have to study how to assign stands (Track 2 10/05/2011).

RCT operators not only have to ensure appropriate gate and stand allocation within the planned lapse of time, but they also have to consider that their planning has effects that overcome each lapse of time planned, thereby undermining stand availability over time. It is therefore strategically relevant for RCT operators to plan in such a way that it does not threaten their ability—or that of the next planners—to allocate stands effectively.

Practically speaking, the operators succeed in preventing planning from negatively impacting the maintenance of the stand availability by drawing on practices that allow for the identification of usable spaces. The identification of usable space consists of evaluating whether stands free at a certain moment correspond with the need for usable spaces. The identification of usable space mostly draws on operators' knowledge of recurring patterns in schedules and is devoted to defining stands that—even in the absence of certain information about the number, movements, and dimensions of the incoming planes—should be kept free as it is likely that they will be needed for planes arriving in the upcoming hours. For example, RCT operators who plan the evening allocation—even if they do not know the number of cargo flights that will arrive that night—reserve an area of the ramp for cargo flights when planning to ensure that stands for those possible flights are available for the next colleagues. At night, arriving planes often remain on ground overnight; without the reservation of some stands, it would not be possible to find parking areas suitable for the incoming cargo flights, which are usually wide-bodied aircrafts and for which it is particularly difficult to find appropriate stands as large stands are limited in number.

The adoption of such planning practice usually makes operators' own planning more difficult: the higher the number of usable stands, the less complex the stand allocation process is because the distribution of aircrafts over several stands facilitates the synchronisation of the use of stands with departures and arrivals. A similar situation occurs when information about the arrival of charter flights is certain.

> Today we know that tomorrow a Tupolev will arrive and that we have to park it at stand 2. The use of stand 2 inhibits the use of all these other stands so we and our colleagues will never assign, for example, stand 1 to another aircraft (Track 6; 10/07/2011).

As such, regardless of whether the information about the movements of planes is certain or not, RCT operators consider the free stands usable as long as this assumption does not interfere with the forthcoming planning, either definitively or potentially.

The RCT operators not only plan to prevent stand unavailability, but also to ensure the availability of stands on the ramp in particular as assisting aircraft on the ramp is less complex in terms of organisation and less time consuming. The RCT operators' planning ensures ramp availability in terms of both planes length on the ground and the ordered use of stands. For example, RCT operators usually assign stands on the apron to planes that stay on the ground for long periods of time. This does not mean that the operators' choices about where to park aircrafts are standardised. If, in fact, an aircraft is expected to stay on ground for several hours but RCT operators consider it likely that the aircraft will be used ahead of schedule, despite the information available to them showing the contrary, they might decide not to park that aircraft on the apron.

> It's the case of Sxxair. Yesterday evening we had a plane that would have remained the whole next day on ground. We know that, if an aircraft needs to be replaced, the Sxxair staff uses the aircraft that is already on ground, so instead of parking the aircraft on the apron to have a stand free on the ramp, we decided to park it on the ramp. This morning, when Sxxair changed the rotation list, we already had the plane on the ramp and were able to board on time (Track 6; 10/07/2011).

In addition, the RCT operators allocate stands for maximum capacity as much as possible so as to keep the biggest parking bays, which are limited in number, free for aircraft that need them.

> I try to use stands for their capacity. I do not park aircrafts in stands that have a bigger capacity because it is not advantageous in terms of space use. As you can see, I can use this self-manoeuvring stand for an airbus but this way we would lose the use of these other stands and this is nonsense. You have to know the stand capacity and to work as the others do (Track 6; 10/07/2011).

Monitoring the duration of handling activities

The RCT operators not only plan so as to prevent stands' unavailability, but also with the aim of keeping the duration of handling activities under control so as not to cause delays in planes' departures. RCT operators do not decide the amount of time necessary for handling planes; the airline companies fix the duration of the turnaround time, although they also recognise that the allocation of stands and gates is essential for contributing to the timely execution of flights. Indeed, the allocation of stands can impact on both the duration of the turnaround activities and the convergence of ramp personnel necessary for the timely assistance of planes on ground to get started.

The methods adopted by RCT operators during the stand allocation for the timely execution of handling activities include measures for both the promotion of the immediate execution of handling activities when necessary and the prevention of circumstances that could increase the time necessary for their execution. The promotion of the timely execution of handling activities is characterised by "time-saving practices"—namely, planning measures that aim to reduce the time necessary for the execution of some of the turnaround activities and for the convergence of ramp personnel at stands when their presence is necessary. The timely convergence of personnel at stands is achieved by minimising occasions that require the personnel's movement on the apron and ramp space as well as reducing the distances that they have to cross. Meanwhile, the prevention of delays is pursued by assigning stands and/or gates with the aim of shortening the time necessary for the execution of specific handling activities as well as by planning to avoid conditions that produce delays in the execution of the handling activities.

Operators promote the timely execution of handling activities by assigning stands so that planes are next to the equipment necessary for their handling. The use of the ramp and apron is arranged among the four handler companies that work in the analysed airport. A specific area of the ramp space is dedicated to each company, and they keep their own equipment for assisting planes in a timely manner in their dedicated space. Although such equipment is movable for the most part, handlers prefer to maintain it in the same place for several reasons. Vehicles can move on the ramp using predefined routes, but the continuous transfer of vehicles exposes them to damage, is expensive, creates traffic jams, and is time consuming. In addition, the continuous movement of supplies increases costs and the risk that handlers will not have them ready when and where necessary. For these reasons, RCT operators usually try not to park aircrafts handled by one company on the ramp space assigned to another company, especially as the airline companies have flights scheduled in the same period of time.

Operators prevent circumstances that could increase the time necessary for the execution of the handling activities through the careful allocation of gates to flights. They try not to assign flights directed to similar destinations in adjacent stands during the same period of time. This approach to planning the use of gates draws on the RCT operators' knowledge of passengers' behaviour. Passengers might be late or misread the monitors, causing them arrive at the wrong gate. The contiguity of boarding of flights with similar destinations can increase such confusion and passengers' mistakes, thereby creating more disruptions in the boarding process. In such cases, passengers can complain, and the operators at the gates have to spend time instructing them, which can slow down the boarding process. Increased boarding time negatively impacts turnaround procedures and, consequently, the possibility for the plane to depart on time. Thus, RCT operators try not to create such unfavourable conditions.

RCT operators also contribute to the timely execution of handling activities through the intensive use of gates connected with stands via fingers instead of those gates which require boarding by bus. Boarding on foot is quicker than boarding by bus. Time saved in passengers' movements can compensate for delays in the execution of other activities, such as passengers' seating. In addition, boarding by foot allows for the containment of the use of buses—a limited resource—and ultimately of the costs of each handling procedure.

Keeping delays under control

Stand allocation can be used to keep delays under control thanks to the adoption of methods for planning that allow for limiting delays when it is foreseeable that temporal boundaries for handling will be exceeded. Ideal conditions for RCT operators' planning are those in which they can allocate stands so as to park all the scheduled aircrafts on the ramp while also respecting safety and security requirements, ensuring the timely execution of handling activities, and meeting airline companies' preferences about the allocation of stands.

However, when the number of flights to park is high, this is not possible, and the operators have to assign planes to stands on the apron. As previously explained, organising assistance for planes on the apron is a complex process as both the equipment and personnel necessary for handling the planes have to be transferred from the ramp to the apron. In addition, such transfers backfire on the organisation of the ramp activities as the time required for ground operators to move back and forth between these two areas increases, making it more likely for delays to occur in aircraft assistance as a whole. Thus, when operators have to plan in less-than-ideal conditions—that is, conditions that will probably cause delays—they allocate planes in such a way to minimise delays, such as by assigning stands on the apron to those passenger flights with the fewest passengers to board or disembark or to cargo flights that only have to load or unload parcels. In this way, the RCT operators succeed in maintaining good relations with all the parties involved in handling planes and with airline companies in particular.

Discussion

As previously mentioned, the careful exploitation of gates and stands allows for the convergence of passengers, equipment, and personnel at gates and stands when necessary. Even if stand allocation involves the organisation of seemingly simple changes in the use of the field (stands, as well as gates, may be free or occupied), the process actually embodies the possibility for handling to take place as expected. Thus, it can be concluded that stands, as well as gates, are not equivalent structures, not only because of their distinct technical features and different positions in the airport space, but also because the allocation of such areas assumes different relevance in terms of their position in the airport space, given the typologies and numbers of flights scheduled in certain periods of time.

As the previous discussion indicated, RCT operators have to deploy a specific corpus of knowledge to deal with problems that emerge during planning in order to ensure the timely execution of handling. The operators' local expertise (Carassa, 2000; Normark and Randall, 2005) related to "how things usually go"—whether in terms of knowing how passengers behave, how flights are usually planned, how changes in the rotation lists are managed by airline companies, or how operators on the ramp deal with the accomplishment of the aircraft assistance—plays a central role in stand and gate allocation. In particular it is our contention that the operators' knowledge of temporality in planning is organised in terms of knowledge of the temporal horizon of planning, the span of planning, and the management of temporal ambiguity.

Temporal horizon and temporal span in planning

The term "temporal horizon" refers to people's use of their knowledge of likely future events for the organisation of their current activities in the absence of protocols that have to be followed in "lock step" (Reddy et al., 2006; p. 42). Reddy et al. developed such a concept primarily to highlight how individuals perceive their own activities as temporally organised, showing how people increase or decrease the pace in the execution of their own activities in order to comply with deadlines. We contend that the concept of temporal horizons can be effectively used to focus on the nature and complexity of problems that people expect to arise when meeting deadlines as well as the modality by which they address such problems.

The temporal horizon of planning refers to the fact that the RCT operators know that the plan setup has temporal deadlines that cannot be exceeded and that they have to arrange their planning to comply with such requirements despite the actual circumstances. The RCT operators' main difficulty in complying with these temporal requirements does not depend on finishing the plan setup in due time, but rather in setting up the plan despite the lack of certain information about flight rotations.

We refer to the operators' knowledge of the duration of the effects of planning in terms of the "temporal span of planning". The temporal span of planning does not correspond with a precise prediction of the effects of planning over time; thus, the evaluation of the impact of one operator's planning can be better described in terms of approximate estimations to which methods for planning correspond. The operators manage both the temporal horizon of planning and its temporal span, drawing on practices that allow for the identification of the usable space and the maintenance of ramp space usability.

Recasting the operators' local knowledge on temporality in terms of the temporal horizon and span of planning allows for a better understanding of the types of problems that planning as a distributed activity imposes on planners, who have to articulate (Schmidt and Simone, 1996) their planning over time. The distinction between horizon and span of planning highlights that the continuity of proper stand allocation cannot be taken for granted; it has to be actively pursued and is achievable only by means of the application of precise planning practices. The operators' practices for the identification of the usable space, in particular, restrict the number of usable stands; although this makes their own planning more difficult, it facilitates their colleagues' subsequent stand allocation. This also means that the practices for planning that make efficient stand allocation possible are the same that allow for the connection of planning over subsequent shifts.[5]

It is also worth noting that all the practices for the management of horizons in the stand allocation optimise the use of the resources at operators' disposal, thereby contributing to the complexity of colleagues' planning as well. If delays occur in the execution of handling activities due to improper planning and flights are not carried out as scheduled, reasonable expectations about plane departures—and thus about the availability of stands—are no longer possible.

Managing temporal ambiguity

Egger and Wagner (1993) defined temporal ambiguity as the effect of the impossibility for organisations to respect temporal boundaries in which work activities are organised. Temporal ambiguity refers to the difficulty organisations face in keeping orderliness and predictability in the execution of work activities. According to Egger and Wagner's definition, organisations face temporal ambiguity by means of scheduling. We contend that the RCT operators are aware of the temporal ambiguity that an improper stand allocation might cause; as such, they adopt measures to both avoid and contain the temporal ambiguity as much as possible when planning.

Stand allocation can be used to prevent temporal ambiguity thanks to the planning methods adopted that allow for handling to be executed in a timely manner. However, it can also contribute to the control of temporal ambiguity when it is foreseeable that temporal boundaries for handling will be exceeded, as previously explained. The focus on temporal ambiguity highlights how planning can contribute to maintaining order at work, thereby enriching our understanding of the use of plans in workplace settings. In addition the description of operators' planning practices for keeping delays under control by controlling the temporal

---

5 In air traffic control, cooperative functions are embedded in the execution of work in a similar way (see: Berndtsson and Normark, 1999)

ambiguity indicates how planning methods allow them to comply with contingent situations and identify which changes in work circumstances trigger such modification in planning methods.

The features of temporal allocation of stands

The analysis of planning practices not only allows for a deeper understanding of planning as situated practice, but also for the revision of the existing definitions of "allocation".

As previously explained, the RCT operators allocate stands with the aim of keeping the duration of handling activities under control so as not to cause delays in planes' departure. However, none of the existing definitions of "allocation" gives an account of what "allocation" consists of for the RCT operators. Malone and Crowston (1994) recognised allocation as a basic process for coordination—namely, for the management of interdependent work activities. They concluded that allocation consists of the process necessary for the organised use of shared resources among different users who often have conflicting interests. Meanwhile, Bardram (2000) suggested that allocation consists of deciding the amount of time to dedicate to various activities according to temporal priorities.

We suggest that theoretical approaches to the study of allocation processes might be inadequate for the comprehension of what allocation consists of in situated contexts and, thus, for the understanding of how people deal with the problems that specific forms of allocation raise. As such, considering the study of "allocation" as a situated phenomenon in order to understand what people mean when using such a term allows for a deeper understanding of how it is related with the solution of time management problems. A definition of "allocation" that better describes RCT operators' practice is the organisation of resources among different users following temporal priorities for the promotion of the timely execution of work activities within certain periods of time.

Deficiencies of constraint programming techniques applied to stand allocation

Existing stand allocation software is based on constraint programming techniques (Hon Wai Chun et al., 2000). Although such software provides the automatic generation of the stand allocation plan, as previously indicated, RCT operators do not rely on the automatic allocation of stands as they consider the software to be inadequate. Such inadequacy stems from the fact that the software is ineffective in sustaining planners' articulations and evaluating the effects of the stand allocation on the coordination of the handling activities. The software does not favour the efficient connection between stages of plans in that it cannot create plans in the absence of certain information about the flight rotations. In addition, automatic stand allocation based on constraint programming techniques fails to consider the effects of the stand allocation on the timely execution of the handling activities. Thus, it seems reasonable to say that, when several solutions to the same stand allocation problem are possible, the operators are better able than the software to choose the stand coherently given their orientation towards the allocation of stands for the timely execution of handling. Ultimately, software for the stand allocation should be interpreted as an "affording mechanism" (Cabitza and Simone, 2012) that, for example, provides alarm codes whenever the stand allocation is inappropriate rather than as a tool that can be used to replace humans in carrying out tasks.

Sustaining the essential coordinative functions of planning the stand allocation

Crabtree et al. (2000) asserted that the main objective of an ethnographic study of work settings for system design should be to understand what to automate and what to leave to human expertise. This research is not oriented to software design; nevertheless, it allows some considerations for the improvement of the system for stand allocation. In fact, even if software for automatic stand allocation can be improved by incorporating the evaluation of further constraints so as to support the plan setup in a more consistent way, it seems unlikely that such software could substitute for humans in the management of stand allocation due to the strong impact of local knowledge on time management in planning.

Instead, we suggest that software should be designed to support planners' articulation of work. This could be achieved by facilitating operators' sharing all information regarding colleagues' planning and the changing state of work useful for the maintenance of the stand availability. In addition, inspired by the RCT operators' practices —and differently from what current research shows— we argue the need to develop software that conceptualises the problems of gate/stand allocation and planes' handling as integrated rather than separated phenomena. This, in fact, could contribute to minimise flight delays and optimise the use of airport's facilities and handlers' resources. Our research highlights the necessity of increasing the integration of airport operations (by increasing the integration of airport operations; see: Atkin et al., 2010; Kelemen, 2004).

Concluding remarks

The successfulness of planning in the RCT depends on the interplay between shared methods for the plan production that allow for both the allocation of resources and the management of temporal constraints while maintaining orderliness and predictability in the execution of work activities. As discussed herein, such a definition of allocation does not correspond with definitions of the same process developed from theoretical points of view—namely, that of coordination theory and activity theory—but rather emerges from the situated study of the setting. We do not contend that this definition of allocation should replace existing ones; instead, we suggest that theoretical approaches to the study of allocation processes might be inadequate for comprehending what allocation consists of in situated contexts and, consequently, how people deal with problems that specific forms of allocation raise, thereby impeding the implementation of software for the coordination of work activities by means of resource allocation. We also suggest that the exclusive automation of stand allocation is insufficient for ensuring the smooth execution of aircraft assistance, which draws heavily on the situated relevance of the operators' local knowledge.

Our analysis of planning enriches our understanding of the use of plans as organisational artefacts in that our study shows how planning can simultaneously impact coordination in time and space by managing the substantive contents of the field. As such, our study enables CSCW scholars to determine how temporality and distance affect coordination as intertwined phenomena that future empirical research can help further clarify.

Acknowledgments

Thanks to Dave Randall with whom we discussed the role of plans in workplace settings.

References

Amerine, R. and Bilmes, J. (1988): 'Following instructions', *Human Studies*, vol. 11, no. 2-3, April 1988, pp. 327-339.

Atkin, J. A. D., Burke, E. K., Ravizza, S. (2010): 'The airport ground movement problem: past and current research and future directions. *Procedings of the 4th International Conference on Research in Air Transportation*. Busapest, June 1-4, 2010, CATSR, pp. 131-138.

Bardram, J. E. (1997): 'Plans as situated action: An activity theory approach to workflow systems', in *Proceedings of ECSCW'97,* Kluwer Academic, Netherlands, 1997, pp. 17-34.

Bardram, J. E. (2000): ' Temporal coordination', *Computer Supported Cooperative Work*, vol. 9, no. 2 May 2000, pp. 157-187.

Bardram, J. E. and Hansen, T. R. (2010): 'Why the plan doesn't hold- a study of situated planning, articulation and coordination work in a surgical ward', in K. I. Quinn, C. Gutwin, J. C. Tang (eds.) *Proceedings of the 2010 ACM Conference on Computer Supported Cooperative Work, CSCW 2010*, Savannah, Georgia, USA, February 6-10, 2010, ACM, pp. 331-340.

Berndtsson, J. and Normark, M. (1999): 'The coordinative functions of flight strips: air traffic control work revised', *Proceedings of the international ACM SIGGROUP conference on Supporting Group Work 1999,* Phoenix, Arizona, USA, November 14-17, 1999, ACM, pp. 101-110.

Bossen, C. and Markussen, R. (2010): 'Infrastructuring and ordering devices in health care: medication plans and practices on a hospital ward', *Computer Supported Cooperative Work*, vol. 19, no. 6, December 2010, pp. 615-637.

Button, G., Sharrock, W. W. (1994): 'Occasioned Practices in the Work of Software Engineers', in M. Jirotka and J. Goguen (eds.): *Requirements Engineering: Social and Technical Issues*, Academic Press, San Diego, 1994, pp. 217-240.

Button, G. and Sharrock, W. (1996): 'Project work: the organization of collaborative design and development in software engineering, *Computer Supported Cooperative Work*, vol. 5, no. 4 December 1996, pp. 369-386.

Button, G. and Sharrock, W. (1998): 'The organizational accountability of technological work', *Social Studies of Science*, vol. 28, no. 1, February1998, pp. 73-102.

Bologna, pp. 123-150.

Cabitza, F. and Simone, C. (2012): 'Affording mechanisms: an integrated view of coordination and knowledge management', *Computer Supported Cooperative Work,* vol. 21, no. 2-3, June, pp. 227-260.

Carassa, A. (2000):'La conoscenza entra in azione', in G. Mantovani (ed.) *Ergonomia,* Il Mulino.

Ciborra C. (2002): *The labyrinths of information*. NY: Oxford University Press

Crabtree, A., Nichols, S. M., O'Brien, J., Rouncefield, M., Twidale, M. B. (2000): 'Ethnomethodologically informed ethnography and information system design', *Journal of the American Society for Information Science,* vol. 51, no. 7 2000, pp. 666–682.

Dant, T. and Francis D. (1998): 'Planning in Organisations: Rational Control or Contingent Activity?' *Sociological Research Online,* vol. 3, no. 2, June 1998, http://www.socresonline.org.uk/3/2/4.html.

Egger, E and Wagner, I. (1993): 'Negotiating temporal orders, *Computer Supported Cooperative Work,* vol. 1, no. 4 December 1993, pp. 255-275.

Garfinkel, H. (1967) *Studies in ethnomethodology*, Prentice Hall, Englewood Cliffs (NJ).

Garfinkel, H. (2002): *Ethnomethodology' s program: working out Durkheim' s aphorism,* Rowman & Littlefield, Lanham.

Hon Wai Chun, A., Ho Chuen Chan, S., Ming Fai Tsang, F. and Wai Ming Yeung, D. (2000):'Stand-allocation system', AI Magazine, vol. 21, no. 4, Winter 2000, pp. 63-74.

Karasti, H, Baker, K. S. and Millerand F. (2010): 'Infrastructure time: long-term matters in collaborative development, *Computer Supported Cooperative Work*, vol. 19, no. 3-4 August 2010, pp. 377-415.

Kelemen, Z. (2005): 'Resource management system- The first step to the airport information system integration, *Periodica Polytechnica Transportation Engineering*, vol. 33, no. 1-2, pp. 15-24

Koskinen I. (2000): 'Plans, Evaluation, and Accountability at the Workplace', *Sociological Research Online,* vol. 4, no. 4., February 2000, http://www.socresonline.org.uk/4/4/koskinen.html.

Llewellyn, N. (2008): 'Organization in actual episodes of work: Harvey Sacks and organization studies', *Organization Studies,* vol. 29, no. 5, May 2008, pp. 763-791.

Llewellyn, N. and Spence, L. (2009). 'Practice as a members' phenomenon', *Organization Studies,* vol. 30, no. 12, December 2009, pp. 1419-1439.

Malone, T. and Crowston, K (1994): 'The interdisciplinary study of coordination, ACM Computing Surveys, vol. 26, no. 1, March 1994, pp. 87-119.

Nilsson, M. and Hertzum, M. (2005): 'Negotiated rhythms of mobile work: time, place, and work schedules. In Proceedings of GROUP'05. Sanibel Island, FL, USA, November 6–9, 2005 ACM, pp. 148–157.

Normark M. and Randall, D. (2005): 'Local expertise at an emergency call centre', in H. Gellersen et al. (eds.), *ECSCW 2005: Proceedings of the Ninth European Conference on Computer-Supported Cooperative Work*, 18-22 September 2005, Paris, France, 2005 Springer. Netherlands, pp. 347–366.

Orlikowski, W. and Yates, J. (2002): 'It's about time: temporal structuring in organizations', *Organization Science,* vol. 13, no. 6, November-December 2002, pp. 684-700.

Randall, D., O'Brien, J., Rouncefield, M. and Hughes, J.A. (1996): 'Organizational Memory and CSCW: Supporting the 'Mavis' Phenomenon, in J. Grundy, M. Apperley (eds.) *Proceedings of the Sixth Australian Conference on HCI (OzCHI '96*) 1996 IEEE, pp. 26-35.

Randall, D., Harper, R. and Rouncefield, M. (2007) *Fieldwork for design*. Springer, London.

Randall, D. and Rouncefield, M. (2011): 'Plans and planning: Conceptual confusions and empirical investigations', in M. Rouncefield and P. Tolmie (eds.): *Ethomethodology at work*, Ashgate, Farnham, 2011, pp. 73-89.

Reddy, M. and Doursih, P. (2002): 'A finger on the pulse: temporal rhythms and information seeking in medical work' in *Proceedings of CSCW'02*, November 16-20, 2002, New Orleans, Louisiana, USA ACM, pp. 344-353.

Reddy, M., Dourish, P. and Pratt, W. (2006): 'Temporality in medical work: time also matters, *Computer Supported Cooperative Work,* vol. 15, no. 1 February 2006, pp. 29-53.

Rönkkö, K., Dittrich, Y., Randall, D. (2005): 'When Plans do not Work out: how Plans are Used in Software development Projects', *Computer Supported Cooperative Work*, vol. 14, no. 5, October 2005, pp. 433-468.

Schmidt, K.and Simone, C.(1996): 'Coordination mechanisms: Towards a conceptual foundation of CSCW systems design,' *Computer Supported Cooperative Work (CSCW): The Journal of Collaborative Computing*, vol. 5, no. 2–3, June1996, pp. 155–200.

Schmidt, K. (1999): 'Of maps and scripts: The status of formal constructs in cooperative work', *Information Software Technology*, vol. 41, no. 6, April 1999, pp. 319-329.

Schmidt , K. (2011): 'Frail foundation', in K. Schmidt, *Cooperative work and coordinative practices*, Spinger, London, 2011, pp. 359-389.

Sharroch, W. and Button, G. (2003): 'Plans and situated action ten years on', *The Journal of the Learning Science*, vol. 12, n. 2, April 2003, pp. 259-264.

Sherman Heyl, B. (2001): 'Ethnographic interviewing', in P. Atkinson, A. Coffey, S. Delamont, J. Lofland, L. Lofland (eds.): *Handbook of ethnography*, Sage, London, 2001, pp. 369-383.

Suchman, L. A. (1987): *Plans and Situated Actions: The Problem of Human-Machine Communication*, Cambridge University Press, New York.

Suchman, L. A. (1997): 'Centres of coordination: a case and some themes', in L. B. Resnick, R. Säljö, C. Pontecorvo and B. Burge (eds.): *Discourse, Tools, and Reasoning: Essays on Situated Cognition*. Springer-Verlag, Berlin, 1997, pp. 41-62.

Vera, A. and Simon, H. (1993): 'Situated action: A symbolic interpretation', *Cognitive Science*, vol. 17, January-March 1993, pp. 7–48.

Whittaker, S. and Schwartz, H. (1999): 'Meetings of the board: the impact of scheduling medium on long term group coordination in software development', *Computer supported Cooperative Work*, vol. 8, no. 3, September1999, pp. 175-205.

Zimmerman, D. (1971) 'The practicalities of rule use', in J. Douglas (ed.), *Understandin everyday life*. Routledge and Kegan Paul, London, 1991, pp.