Working apart together : using ICTs in research collaboration
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Conclusions

In this final chapter I first compare and contrast in a systematic way the results obtained from the two case studies which help me answer the initial research questions: How do differences among media influence research collaboration? How do processes of research collaboration influence the frequency of media use? On the basis of this comparison, I first propose a theoretical model which helps us understand the interactions between collaboration and media use (global dynamics variables), and develop a set of hypotheses for further research. Second, I examine some methodological challenges and implications of the study, namely the use of ARIMA models, the use of real-time online data, and the study of the bi-directional relationship between media use and social phenomena. Third, I discuss the general theoretical insights from the study about the interaction between research collaboration and communication media. Finally, I draw some policy implications on the basis of the two case studies about European Union Framework Programme projects.
A. Comparison of the two cases

Here, I first describe the results of the analysis of the two projects, recapitulating their main differences. Then, I turn to the similarities of the two case studies and answer the main research questions of the dissertation. On the basis of this, a model of how different aspects of research collaboration relate to each is deduced, and a set of hypotheses for further investigation are elaborated.

The DELTA project aimed at studying the influence of the use of email on organizational processes, asking thus a rather traditional sociological research question, and having as intended output academic reports. The team consisted of members with more or less similar expertise within the broad social sciences, based in universities, and exhibiting thus a relative homogeneity in terms of approaches to the subject matter. The initial task allocation between the groups was unspecialised, since all of the groups were involved in almost all stages of the project, making it thus an integrative collaborative endeavour and requiring intense team-wide interdependence. The level of formalization of the project was high, as – apart from the usual FP requirements (see chapter 2 section C) – the team had laid down in the contract precise rules for decision-making processes, conflict-resolution, recording of minutes etc.

The general emailing list played the most important role as the medium for everyday communication and coordination, for all working processes of collaboration. In addition, a managerial list, a website and the blackboard were also used for team-level communication and collaboration. Meetings were not frequent, and had a formal character; they were used for all working processes of the team, but mainly for task allocation and coordination, and decision-making processes. The functions that the media sustained were stable in time. The use of the two emailing lists showed limited sensitivity to random shocks, and negative feedbacks, moving back to their equilibrium after each shock, and the process underlying their use was stable in time. In short, the communication dynamics showed relatively low complexity; the team produced a stable communication activity and managed to reproduce its communication patterns through time.

The work was organised and coordinated at a team-wide level: tasks were broken down in subtasks and they were assigned to subgroups with a rather formal character. This division into discreet subtasks reduced the initially high degree of interdependency and transformed tightly-coupled tasks into loosely-coupled tasks. The team-wide coordination was quite successful, with reports generally delivered on time to the project officers, positive evaluation and overall assessment. The collaboration patterns reflected a pluralistic contested leadership, with four competing levels of authority which often held each other in balance during decision-making processes. These multiple contesting levels of authority sometimes created tensions and conflicts in the team, as each tried to take control of the project’s progress and resources. An additional source of tensions and

\[78\] With the exception of the managerial list.
The ERICOM team aimed at developing and testing new indicators using web- and non-web data to describe processes at the interface of science, technology, and economy, together with the development of software tools. The team had thus a risk factor imprinted in the research design (to develop something new) and the intended output, apart from the traditional academic, also consisted of databases, software tools, visualisation tools and information platforms. The team consisted of experts from different fields (social scientists, information scientists, engineers and computer scientists) based in universities, private research centres and intermediaries which were also interested in using the new indicators, exhibiting thus heterogeneity in terms of the approaches to the subject matter. The initial task allocation between the groups was specialised, as some groups were responsible for gathering data, others for building the analysis tools, and others for conducting the analysis, making it thus a complementary collaborative endeavour. At the same time, all research stages (data gathering, analysis etc) run in parallel. All these factors contributed to higher complexity in ERICOM, compared to DELTA. In addition, the level of formalization of the project was low, as – apart from the common FP requirements – the team had not specified additional coordination or communication mechanisms in the contract.

General and bi-lateral meetings played the most important role for team-wide communication and coordination, and for all working processes of collaboration. The two emailing lists (the general and the managerial) were used less. The frequency of media use, as well as their functions changed considerably throughout time. The use of media showed greater sensitivity to random shocks, path dependence to initial random shocks, often with turbulent fluctuations at higher values, and no return to equilibrium after each shock. ERICOM did not manage to create stable communication patterns throughout time. The team exhibited higher complexity, also because of higher uncertainty.

The work was organised and coordinated at a bilateral level, through informal mechanisms, and initiative taking. Team-wide coordination and task allocation was very problematic, which also resulted in delays in managerial and substantial tasks, and negative evaluation from the project officers. The team had a problem reaching decisions, with different levels of authority without any authoritative voice, and diffusion of collective responsibility. The coordination vacuum resulted in tensions and conflicts; it was solved through the hiring of a professional manager, who acted authoritatively, sometimes without informing the team, which also created tensions. A sense of collective responsibility and identity began to develop in the first year, also through team-wide socialising, but after the resignation of group 4 it disappeared. Even though the team performed poorly from a managerial point of view (it received negative evaluation from
the project officers), the output produced based on the project was substantial and continuous: even now there are ERICOM results being published.

This brief description of the two projects emphasised their differences. Indeed, the media configuration and the collaborative working practices in the two teams were quite different. However, there are similarities between the two cases, apart from the ones relating to their setting as FP project collaborations. The similarities relate, more precisely, to the ways in which differences among media influenced collaborative working practice, and collaboration practices influenced in turn the use of communication media, in a process of mutual shaping. Thus, their similarities are in the interrelation between the global variables. I here review the answers to the two main research questions and develop a set of hypotheses for further research. These hypotheses are expected to hold for geographically distributed, multi-institutional collaborations, as FP project collaborations are. I elaborate on this point further on..

1. How do collaborative working practices influence the use of media?

In both cases, the use of ICTs interacted with other, more traditional communication media, such as face-to-face meetings, to create a distinctive media configuration in each team. Even though the media configuration in the two teams was different, there was a similarity in how each medium functioned in the context of each team. In DELTA, most of the work was team-wide, with a non-specialised initial allocation of tasks among groups: every group participated in almost every stage of the work; as a consequence, every participant needed detailed information about how work was going on in other local sites. Since the questionnaire of the team was supposed to be used by all groups involved, it needed to be accepted and reviewed by the whole team (chapter 6, section E). This means that it was necessary that it be sent to the whole team explicitly, that is, to every member in the team while knowing and making sure that all other members also received it. This is the reason the most frequently used medium was the general, team-wide emailing list: because not only did it provide access to all members, but, it provided explicit access to all members (chapter 2, section A).

In ERICOM, most of the work was either individual, or involved two or three local groups. Moreover, the task allocation was specialised, reflecting the different expertise of members of the collaboration, with different groups involved in the data gathering process, and other groups involved in the development of analysis tools. Group 6 did not need to know anything about the technical details of work in WP2 because they were not involved in it. We can imagine that a WP-based emailing list, (providing explicit access to information about each WP to the members involved in that specific WP) would not have functioned either, because of the different expertise in the team. For instance, even though group 5 and group 2 collaborated on WP5, group 5 would not have been able to understand or assess technical information about the development of the visualisation tool conducted by group 2. As a result, the only team-wide information necessary was a general idea about the stage of work of each group. Therefore, the coordination, information exchange and communication needs of the team were mostly covered
through personal media: ICTs such as personal emails, more traditional media such as telephone calls or bilateral face-to-face meetings.

In both teams, therefore, the initial task allocation, which showed how integrative or complementary the project was, in combination with the variety of expertise of the participants, influenced which type of communication media was used the most: personal or (team-wide) public. In the integrative project, without much variety of expertise among members, a team-wide communication medium was needed to cover the information and communication needs and was used the most. In the complementary project, with a wide variety of expertise among members, personal media were needed to cover the information and communication needs and were used the most. The following hypotheses can be deduced:

H1: In geographically distributed research collaborations, the initial task allocation in combination with the variety of expertise of the participants influence the extent to which personal media or team-wide media will be used.

H1a: In integrative distributed collaborations without much variety of expertise, team-wide communication media will be used the most.

H1b: In complementary distributed collaborations with a wide variety of expertise, personal or bilateral communication media will be used the most.

Or in a more abstract way\textsuperscript{79}:

\textit{Initial task allocation + Variety of expertise} → \textit{Media configuration (type of media used)}

Therefore, how do collaborative practices influence media use? The initial task allocation between the partners, as well as the variety of expertise among the members of a collaborative endeavour influence the extent to which public or private media will be used the most by the team.

\textbf{2. How do differences among media influence collaborative working practices?}

In both cases, the use of different media for decisions, conflicts, socialising and output production resulted in different dynamics of these processes, (chapters 6 and 8 sections A, B, C, E, respectively). The analysis showed that differences among media influence research collaboration by influencing the communication processes in it.

The decision-making process in DELTA involved four intertwined but analytically separate levels of authority, all of which attempted to steer the project in a desired course, ending in a power balance, which resulted in a pluralistic model of decision-making. Under these circumstances, when decisions were taken in public media, such as meetings and the general list, the decisions were more participatory and had to be justified: the

\textsuperscript{79} This abstract way of representing the relationship between two concepts is necessary here as it is part of the proposed model.
argumentation often evoked the “team”, or “all”. Through the managerial list, which had restricted access, the decision-making process was less public, and therefore more open to manipulations (such as vetoing without explaining the reasons, or threats).

In contrast, in ERICOM, the style of leadership in the beginning was laissez faire and very tolerant: in fact very few decisions were taken by the team, before the new manager came (coordination vacuum). The use of the general list for decision-making processes did not end up in decisions being taken, because the general accessibility of the medium enabled the diffusion of responsibility and thus the ignoring or postponement of issues. In meetings, this diffusion of responsibility was impossible, because of the shared time-place coordinates: when an issue was raised, the coordinators or representatives of each local group were asked for their opinions.

In both teams, therefore, the degree of publicness of the medium and whether it involved shared time-place coordinates (face-to-face meetings) influenced the process of decision making, with the style of leadership as an intervening variable influencing this relationship. In the project with a pluralistic contested leadership, the use of public media for decision-making resulted in more participatory processes and argumentation of the proposals; whereas the use of restricted-access media resulted in possible manipulations of the decision-making process. In the project with laissez faire style of leadership, the use of a team-wide medium without shared time-space coordinates enabled the diffusion of responsibility, with no decisions being taken. In comparison, decisions were taken in meetings, where the representatives of each group took on their responsibility. The following hypotheses can be deduced:

H2: In geographically distributed research collaborations, the degree of publicness of a medium and the extent to which it allows face-to-face interaction influences the way in which decisions are taken, with the style of leadership acting as an intervening variable of this relationship.  
H2a: With a contested, pluralistic style of leadership in distributed research collaboration, the use of public media will result in a more participatory decision-making process, a need to justify suggestions and proposals, and an evocation of the “team”. In contrast, the use of less public media will result in possible manipulations of decision-making processes.  
H2b: With a laissez faire style of leadership in distributed collaboration, the use of public electronic media will result in the diffusion of responsibility, decisions will be postponed and issue ignored. In contrast, decisions will only be possible in face-to-face meetings because of the focussing of responsibility.

Or in a more abstract way:

\[
\text{Media configuration} \rightarrow \rightarrow \rightarrow \text{Decision-Making process} \uparrow \\
\text{Style of leadership}
\]

Decision-making processes in both teams sometimes sparked tensions and conflicts: in DELTA the lack of consensus over how to subcontract group 8 (chapter 6, section A) led
to insults and frustration. In ERICOM, both the unsuccessful management of the coordinator and the authoritarian style of the later project manager (chapter 8 section B) led to tensions and conflicts. The link between decision-making processes and conflicts was already expected according to the literature review of research collaboration (chapter 2, section B). However, the use of different media also influenced conflicts, and more precisely influenced the conflict-resolution mechanism.

In the both cases, the use of public communication media for the “playing out” and communication of the conflict resulted in more people being involved in the conflict resolution mechanism, which resulted in different translations of what exactly the problem was and how it could be resolved. Different members translated “the problem” in different ways, opting for different solutions, also according to their strategic interests. The use of a public medium also meant that each translation and solution had to be justified and negotiated. At the same time, the power balance became more complex, as more members got involved in the conflict through public media. The end solution was one coming out of this complex power struggle, one out of the many solutions provided.

In contrast, the use of private media for the acting out and the communication of a conflict meant that the actors involved managed to push their own translation of the problem and solution and impose it on the rest of the team. As in any social situation, one of the parties involved had more power, and that was the member translating the situation, and therefore defining the way “the problem” should be solved. This happened not only in the first conflict between the researcher and the coordinator of group 2 in DELTA (chapter 6, section B), but also with the tension which led to the resignation of group 5 in ERICOM (chapter 8, section B).

In both teams, therefore, the degree of public-ness of a medium influenced the conflict-resolution mechanism, and the potential outcome of the conflict. When a conflict took place and was communicated through the public medium, more members got involved, translating the “problem” in different ways and thus suggesting different possible solutions, altering the power balance between the contesting parties. The end solution was negotiated and justified. When a conflict took place and was communicated through a personal medium, the party with the most power among the contesting parties was the one translating the problem and thus imposing the solution. The following hypotheses can be deduced:

H3: In geographically distributed research collaborations, the degree of public-ness of a medium influences the way in which conflicts are resolved as well as the end solution of the conflict.
H3a: The more public the communication medium in which conflicts take place and are communicated, the more members get involved, translating the problem at hand in different ways and thus offering different possible solutions, altering the power balance between the contesting parties. The end solution will be negotiated and justified, and will be one from the pool of different proposed solutions.
H3b: The use of personal media for the acting out and communication of a conflict will enable the party with the most power among the contesting parties to define the problem and impose his/her solution.

Or in a more abstract way:

Media configuration → Conflicts

The tensions and conflicts in a team did not necessarily exclude socialising activities, such as jokes, seasonal wishes, and emotional support, both during face-to-face meetings and through ICTs. The use of meetings for socialising and emotional support was already expected (chapter 3, section E), whereas there was still contradictory evidence for the use of ICTs for socialising and emotional support, since some studies claimed that ICTs “do away with pleasantries” (Kiesler and Cummings, 2002; Aubert and Bayar, 1999).

In both teams, apart from face-to-face meetings, the general list was also used for socialising and emotional support, jokes, and emoticons. In DELTA, this socialising activity through the general list showed linear increase in time, and was independent from face-to-face meetings. It was related to the overall sense of responsibility and attachment to the project, since it was a significant characteristic of the researchers of the team. In ERICOM, the socialising activity through the general list was prevalent in the first phase of the team, but it decreased in time and changed character: jokes, emoticons and emotional support disappeared; pleasantries and the expression of politeness between the members became more prevalent. However, socialising during face-to-face meetings did not decrease.

In both teams, therefore, ICTs were used for socialising and emotional support, and this helped create the feeling of a collective shared identity. But it was not enough to sustain this collective identity. I argued that the continuous problems that ERICOM had to face and tensions between the managerial and the scientific mentalities in the project eroded this collective identity. Moreover, face-to-face meetings proved the only medium which the team used to socialise in the second phase of the project. But this was not enough to sustain a shared identity as a feeling of collective responsibility towards the project.

In both teams, therefore, public media were used for team-wide socialising and emotional support, both face-to-face and electronic. This is inevitable when a team works together towards a common goal (Haythornthwaite, 2001) and it contributes to (and at the same time reflects) the emergence of a shared identity as collective responsibility. However, successful team-wide coordination is vital for the maintenance of a shared identity: when team-wide coordination is problematic and unsuccessful, this shared identity erodes. This results in a decrease in the use of ICTs for socialising, but doesn’t necessarily affect face-to-face socialising. However, face-to-face socialising is not by itself enough to maintain the collective identity in a geographically distributed team. When the team-wide coordination is successful and the team manages itself well, socialising through ICTs and socialising through face-to-face meetings reinforce and sustain the collective identity, which in turn reinforces socialising activities and emotional support. The following hypotheses can be deduced:
H4: In geographically distributed research collaborations, ICTs together with face-to-face meetings will be used for team-wide socialising and emotional support, which will contribute to the emergence of a collective identity.

H5: The sustaining of this shared identity and the dynamics of the socialising activity through ICTs will depend on the success of team-wide coordination.

H5a: If the team-wide coordination is successful, socialising activity through ICTs will increase through time and it will reinforce and be reinforced by the sense of shared identity.

H5b: If the team-wide coordination is unsuccessful and problematic, the shared identity will erode and socialising through ICTs will decrease in time and become a random activity.

H5c: In those cases that team-wide coordination is problematic and unsuccessful and a shared identity erodes, socialising during face-to-face meetings may continue, but it will not be enough to re-create or sustain the shared identity.

Or in a more abstract way:

\[
\text{Media configuration} \rightarrow \text{Socialising} \leftrightarrow \text{Collective identity} \\
\uparrow \quad \uparrow \\
\text{Team-wide coordination}
\]

In both teams, the use of different media for the process of output production influenced the type of output produced, with the variety of expertise in the team being the intervening variable. In DELTA, with members from the broad area of social sciences, almost everyone had an opinion about how a questionnaire should be structured, and what scale should be used. When the questionnaire was sent as an attachment through the general list for comments, therefore, most members commented on it, which made the questionnaire a negotiated, “chewed” product, with many rounds of revisions and feedback from the team. In contrast, the local reports on the key issues which were sent to group 5 via personal emails and were uploaded on the blackboard did not receive any comments.

In ERICOM, the sending of a deliverable through the general list often sparked comments, as well as the presentation of ongoing work during face-to-face meetings. This, however, did not result in a negotiated or “chewed” type of output. The comments were of a different kind, because the members did not have the expertise necessary to comment on the technical details of the output. Thus, the building of the software tool was rarely discussed; what was discussed was its functionality for other local groups, or the format of the results it produced. The use of public media there led to a more heterogeneous type of output, in the sense that the output was also aligned with the insights and expertise of the other team members. It was not a negotiated product, but a multi-dimensional, multi-faceted product. For instance, a sociological report also incorporated technical details of the building of the analysis tool. The report of the visualisation tool also incorporated usability suggestions. We need to keep in mind, however, that this refers to the process of internal output production of the team: so
deliverables to the Commission, not external output to the wider scientific community (published articles or book chapters).

In both teams, the communication of output or draft versions through media other than face-to-face meetings or the general list did not result in comments or feedback. Even when a deliverable was uploaded on the online area of the teams, which meant that it was accessible to all, it was rare that comments on it were given. So, the differentiating factor between the media here is not simply their general team-wide accessibility, but more the explicitness of access: an attachment through the general list made the output available for everyone and at the same time everyone was aware that it was available for everyone. If someone downloaded a document from the online restricted area it was a communication or interaction in private. In short, the explicitness of general accessibility of a medium resulted in comments and feedback from the team.

In both teams, therefore, the use of public media, with explicit general accessibility (the general list and face-to-face meetings) resulted in a shared output production, in terms of comments and feedback to the draft output, whereas the use of private media did not lead to shared text production. The type of output resulting from a shared output production was dependent on the variety of expertise of the members. In DELTA, where there was little variety of expertise, the use of public media for the exchange of work resulted in a negotiated, “chewed” product. In ERICOM, with a wide variety of expertise, the use of a public medium for the exchange of work led to a more heterogeneous, more multi-dimensional product which incorporated elements from other expertise and viewpoints. The following hypotheses can be deduced:

H6: In geographically distributed research collaborations, the degree of explicit public-ness of a medium influences the process of output production and the type of output, with the variety of expertise acting as an intervening variable of this relationship.

H6a: In distributed research collaborations, the use of public media for the exchange of work will result in comments and suggestions from many other team members, whereas the use of media without explicit general accessibility will not result in the exchange of comments and feedback.

H6b: With little variety of expertise in distributed research collaborations, the use of media with explicit general accessibility will result in a negotiated, less “edgy” output of the team.

H6c. With wide variety of expertise in distributed research collaborations, the use of media with explicit general accessibility will result in a more heterogeneous multi-dimensional type of output.

Or in a more abstract way:

\[
\text{Media configuration} \rightarrow \text{Type of output} \uparrow \text{Variety of expertise}
\]
These six hypotheses developed above answer the second research question of the dissertation: how do media configurations influence the process of research collaboration? The degree of publicness of a medium used and the explicitness of this publicness influence the process of decision-making, the resolution of conflicts, the degree to which a shared collective identity will emerge, as well as the type of research output. There are, moreover, additional similarities between the two cases, coming out of the four previous chapters, which refer to how processes of research collaboration interact with each other, and how they are influenced by additional factors.

The intended output, in both teams, together with the variety of expertise of the members influenced the initial task allocation. In DELTA, the intended output was textual in nature and homogeneous (reports). Moreover, all participants were from the social sciences, with similar expertise. This resulted in an initial allocation of tasks which was integrative: all partners being involved in almost all tasks. In ERICOM, the intended output was not only textual, but also software tools and databases. In addition, the variety of expertise was wider, with engineers, mathematicians, computer scientists and social scientists working together. This led to a complementary and specialised initial allocation of tasks: some partners involved in the gathering of data, other partners in the development of analysis tools, others in theorizing. The following hypotheses can be deduced:

H7: In geographically distributed research collaborations, the intended output and the variety of expertise of the members influence the initial task allocation.

H7a: In distributed research collaborations, a homogeneous and traditional intended output and members with little variety of expertise will result in an integrated task allocation, with almost all members being involved in all tasks.

H7b: In distributed research collaborations, a heterogeneous intended output and members with wide variety of expertise will result in a complementary task allocation, with a specialised division of labour among members.

Or in a more abstract way:

\[ \text{Intended output} + \text{Variety of expertise} \rightarrow \text{Initial task allocation} \]

At the same time, the initial task allocation influenced the team-wide coordination of the project. In DELTA, with an integrative allocation of tasks, the shared tasks were broken down in subtasks with a low degree of interdependence, and thus tightly-coupled work was uncoupled. Further, formal communication rules were followed (Olson and Olson, 2000). These two elements resulted in a successful coordination, because the degree of interdependence of the partners (and thus the complexity of the project) was reduced. Moreover, the integrative task allocation led to team-wide coordination through team-wide media. In contrast, in ERICOM, the complementary and specialised allocation of tasks led to bilateral and local coordination efforts. In the one integrative task the team had to perform (WP8), team-wide coordination proved unsuccessful, not only because of many managerial problems the team had to face, but also because there were no formal communication rules the team could follow, and the work was not broken down in subtasks. In the second phase of the project, coordination of WP8 became feasible.
because of formalisation of communication and the uncoupling of dependencies. The following hypotheses can be deduced:

H8: In geographically distributed research collaborations, the initial task allocation influences the team-wide coordination of the team.
H8a: In distributed research collaborations, an integrative collaboration will result in team-wide coordination procedures, whereas a complementary collaboration will result in bilateral and local coordination procedures.
H8b: In integrative distributed research collaborations the formalization of communication rules and the break-down of integrated tasks (tightly-coupled work) are necessary for the success of the team-wide coordination.

Or in a more abstract way:

Initial task allocation $\rightarrow$ Team-wide coordination

However, the initial task allocation was not the only factor influencing the team-wide task allocation and coordination. Decision-making processes also influenced team-wide coordination. In DELTA, decisions were based on a pluralistic model, with multiple contesting levels of authority which held each other in balance and this balancing resulted in a successful coordination: the team managed its tasks well. The ERICOM team, in the first phase, was unable to take decisions, because of the laissez faire mentality of the coordinator. In the second phase, decisions were taken, but were not communicated to the team. In both phases, team-wide coordination proved problematic and unsuccessful, as the team did not manage its tasks successfully. The following hypotheses can be deduced:

H9: In geographically distributed research collaborations, the style of decision-making process influences the team-wide coordination of the team.
H9a: In distributed research collaborations, a pluralistic team, with multiple contesting levels which hold each other in balance, team-wide coordination will be unproblematic and successful.
H9b: In distributed research collaborations, when no decisions are taken because of laissez faire leadership or the decisions are not communicated to the team because of authoritative leadership, team-wide coordination will be problematic and unsuccessful.

Or in a more abstract way:

Decision-making process $\rightarrow$ Team-wide coordination

The decision-making processes were sometimes, as we saw in both teams, the sources of tensions and conflicts. In DELTA tensions and conflicts were created because the multiple levels of authority tried to steer the project to their desired course and impose their authority. However, this was not possible because there were many levels of authority, and this sparked tensions and conflicts in the team. On the other hand, in ERICOM, the inability to take decisions, and the laissez faire attitude of the project coordinator sparked tensions and conflicts, as did the authoritative, not-informative
decision style of the project manager in the second phase of the project. The following hypothesis can be deduced:

H10: In geographically distributed research collaborations, there is no type of decision-making process that does not entail the possibility of team-wide conflicts. In other words, all decision-making styles may lead to conflicts.

Or in a more abstract way:

**Decision-making process → Conflict**

In addition, the decision-making processes were influenced by the degree of formalization of the project. Even though both cases had a relatively high degree of formalization, (if we compare them with an ad-hoc collaboration between two peer researchers on a paper of common interest), because they were both FP projects, the DELTA team had prescribed in the contract the rules for decision-making processes in a very detailed way, also in cases of disagreement. In contrast, ERICOM had not, and when the crises arose, the members had no clear idea of what was expected of them in the decision-making process. So, even though the coordinators (the management committee) discussed the crisis situation, no decision was taken, because they did not agree. The following hypotheses can be deduced:

H11: In geographically distributed research collaborations, the degree of formalization of the project will influence the decision-making process.

H11a: A high degree of formalization will result in decisions being made and not postponed, even in crisis situations.

H11b: A low degree of formalization will result in decisions being postponed in crisis situations.

Or in a more abstract way:

**Degree of formalization → Decision-making process**

These eleven hypotheses can be schematically represented with the following model (Figure 17), where the abstract depictions of the relationships between the variables can be seen. The elaboration of hypotheses so far explains what the arrows between the variables mean and how different values of the variables relate to each other.
This model describes how the dynamics of multi-institutional, distributed research collaborations function, with different factors and processes influencing each other in different ways. However, there are results from the two case studies which are not depicted in this model or discussed so far. These results refer to additional issues and expectations from the literature review (see chapter 3), which were either not confirmed by the analysis or remained unresolved. I will review them here, in the order they were discussed in chapter 3, concluding in this way the comparison between the two cases.

With regards to the interrelations between media, the research question related to whether media which perform similar functions substitute each other or reinforce each other. The media configurations of the two teams were different, not only with regards to the media used, and the functions they performed but also, as I discussed before, the stability of the media configuration. However, in neither of the two teams was there indication of a substitution effect between different media. In DELTA, meetings boosted the use of all other media beforehand (or afterwards for the uploading activity), and the increased use of blackboard was related to the increased use of all other media. In ERICOM, the two lists boosted each other and the attachments of the managerial list boosted the downloading activity was found. Therefore, the analysis showed that media reinforced each other.
In relation to the dynamics of media configuration in time, there were three expectations discussed: First, that communication media would perform different functions at different stages over time and would be used in a different way. Second, that the use of ICTs would increase the pace of working processes in the team. Third, that deadlines and meetings would increase the use of communication media, and especially email. *The expectation of the diversity of media functions over time turned out to be imprecise.* The functions of different media in the DELTA team were stable through time, whereas in ERICOM not, and this was discussed in terms of higher or lower degree of complexity in the team. In addition, *there was no evidence that the use of ICTs increased the working pace of the teams:* the analysis of the DELTA team, which used the general emailing list the most, showed that the pace of the working processes such as decisions were unrelated to the use of ICTs, but related to whether there was general consensus in the team. The analysis of ERICOM did not indicate any acceleration of the working pace either.

Deadlines did not have a systematic effect on media frequency in the two teams (with the exception of a slight increase of the general list attachments 3 weeks in advance in DELTA). Finally, the meetings in both teams increased some communication activity (general list and blackboard in DELTA; general list attachments in ERICOM). Especially in this respect, the idea of an anticipatory system was introduced, as the anticipation of the meeting (and the deadline) caused a change in the media frequency in advance. *Therefore the expectation of meetings and deadlines increasing the use of other communication media seems context-specific and restricted to specific media.*

Moreover, different types of time dynamics were discussed in section 3b. The empirical analysis showed recursive-ness in both teams, and for most media: that is, communication building up on previous communication, and even reverse recursive-ness, communication building on subsequent communication (anticipation). The media that did not exhibit recursive-ness were the media whose use was formalised. There were also random fluctuations, in both teams, in all media, as expected. There was a deterministic element in the management lists in both teams, since the level of managerial communication decreased over time, probably due to learning effects and routines. There was also a permanent effect identified in the case of media frequencies in ERICOM, of the resignation of the local group, which from that time onwards decreased the level of communication in the general list and increased the attachments of the management list. Finally, there was also stability of the media frequencies in DELTA (except from the management list) and I showed how this was related to low complexity in the system, with negative feedbacks. The analysis showed that some of these elements are combined with each other, and therefore four types of media dynamics were identified: a. non-recursiveness (blackboard DELTA; meetings) b. Recursive media with stability and random fluctuations (general list and its attachments DELTA) c. Recursive media with random fluctuations and gradual time trend (learning in managerial list DELTA) d. Recursive media with random fluctuations and permanent effect of random shocks (both lists and internal forum ERICOM).

Decision-making processes were discussed in terms of the peripherality hypothesis, which holds that the use of ICTs will influence the status of the participants in a team,
making processes of decision-making and output production more participatory and open for peripheral (young, less privileged) researchers. In both projects, the use of media was different for researchers and coordinators: in DELTA researchers participated much more than coordinators in the team-wide medium, and considerably in the managerial list. In ERICOM, coordinators participated substantially more than researchers in both lists. This difference however did not result in more participatory decision-making processes in DELTA, and less in ERICOM. Decisions were more inclusive in both teams when they took place through public media, electronic or face-to-face, as suggested above. The peripherality hypothesis was not confirmed.

With regards to conflicts and tensions in distributed teams, four expectations were discussed. First, that the use of ICTs would spark disagreements in the team, especially by creating misunderstandings and by leading the collaborators to stick to their own position rather than engaging in negotiations. Second, that face-to-face meetings, and especially at specific points in time, would help the resolution of conflicts. Third, a shared team identity would alleviate tensions in the team. Fourth, that the recognition of technology effects would help prevent technology-related disagreements. The analysis showed that the use of ICTs per se did not result in disagreements or misunderstandings between the participants, or the sticking to one’s one position. In DELTA, for instance, where conflicts took place through both lists, a negotiation process would always take place. The lack of technology-related disagreements in the two teams could be related to the fact that both teams were aware of technology effects, given that they were both studying ICTs, as expected by Hinds and Bailey (2003). A shared team identity did not necessarily prevent conflicts, especially in the case of DELTA, which had a shared identity, but also frequent conflicts between members. At the same time, there were also conflicts during face-to-face meetings in both teams, and meetings did not necessarily help prevent conflicts.

Relating to coordination processes in the team, the first expectation was that coordination would mainly take place in face-to-face meetings, which was true for both teams, even though informal changes and everyday coordination of subtasks took place in DELTA through the general list. It is more precise to say that team-wide coordination was mostly performed in meetings, when the task was introduced. In the course of the task, coordination, when needed, was performed on a daily basis through the general list, or personal media, for the case of ERICOM. Moreover, the expectation about tightly-coupled work requiring formalized communication rules to succeed was confirmed, as I discussed above, as was the expectation about loosely-coupled tasks (tasks with little interdependency) being easier to coordinate over long distances. This was shown with the analysis of the DELTA team, which broke down tightly-coupled work into loosely-coupled work that was easier to coordinate between the different local groups. Also in ERICOM, in the second phase, the complexity of WP8 was reduced by formalising the work and the communication procedures and by reducing the number of participants.

So far, I have compared and contrasted the results of the two cases on the basis of the two general research questions of the current dissertation, as well as the detailed expectations. This has produced a model, as a set of hypotheses, of how multi-institutional,
geographically distributed research collaborations function, as an interaction between working processes and media configuration. These hypotheses, together with the issues that remained unresolved can be tested with further research of FP project collaborations, as well as other types of dispersed multi-institutional collaborations. Even though these two collaborations were quite specific with regards to FP5 regulations they had to adhere to, I believe that some of the hypotheses will be relevant for and applicable to different types of multi-institutional distributed collaborations as well.

As discussed in chapter 2, we can understand the two research teams as complex systems which interacted with local elements (groups and members) and the contexts (the local and the EU-based) in which they were embedded. Most research in complex systems starts with conceptualising the object of study as a complex system, and then, building on this assumption, the analysis brings in new insights. In this dissertation, I have done the opposite. I have analysed my objects and on the basis of the results, I suggest that it is valid to treat their set of communications as a system, with higher or lower degree of complexity. In this respect, ARIMA analysis proved less a-theoretical than its critics have suggested in the past, helping me to identify and validate the notion of a complex system (see also next section). Even though the teams exhibited different levels of complexity, one or multiple equilibria, and more or less pronounced path dependency, the analysis showed how in both cases, communications were used to separate the team from its environment (constitution) and communications followed a recursive pattern, building on their past.

Both teams had fuzzy boundaries that separated them from and connected them to their embedded contexts (Arrow et al., 2000). The conceptualisation of the research teams as complex systems proved useful insofar as it helped us understand the different dynamics of their communication systems, as well as the interrelations of the global variables. The current research focused on the dynamics at the global level (team-level), and briefly sketched the connections with the local and the contextual dynamics, only when they became traceable at the team-level.

This conceptualisation of research teams as complex systems is also helpful in specifying further research directions. The testing of the proposed model can be based on the twofold research design of case study and computational models (Arrow et al., 2000). The case study approach is important in order to have access to real-time online data about the use of ICTs, which can help us distinguish between different types of interactions (e.g. email and attachments; general and managerial list etc). Moreover, case studies result in thick analysis of the processes involved and can therefore take into account other factors which were not incorporated in the design of the current dissertation, factors relating to the local dynamics of the teams, and the contextual dynamics. The case study design followed here developed a set of hypotheses. These can be validated with the use of computational models (agent-based modelling) which could take into account time as a variable and thus the dynamic character of the relationship between collaboration and media use. Agent-based modelling can replicate results under different circumstances, which is otherwise impossible in real life scenarios. An agent-
based model would explore these hypotheses, and would test which of these rules are most influential in the development of research collaborations.

There are some limitations of the current study: the projects had a very specific format (FP5 collaborations). Further, certain elements were not taken into consideration, especially at the local and contextual dynamics. For instance, the interaction of each member with her local context was not analysed in a detailed way, but rather hinted at: were the members full-time or part-time employed in the project? Did they have other obligations in their local institute that may have influenced the dynamics of the team? How were the personal interactions between the team members patterned and how did that affect the team-wide interactions? The current dissertation focused on the level of the team and the team-wide processes; the local group-level interactions, as well as the interactions with the external environment were only briefly glimpsed. These questions can guide further research.

The limitation of not looking at local dynamics may have created a bias in terms of more team-wide data available for the integrative team (DELTA) than for the complementary team (ERICOM), where more bilateral and personal communication media were used (see Hypothesis 1 above). This does not invalidate the results obtained here, since the question pertained to how team-wide processes influenced each other (global dynamics), and how they differed in the two projects. The implication is that what may have been lost as data sources (personal and local communication and collaboration) was probably more influential in ERICOM than in DELTA. Therefore, further research on how local dynamics contribute to global dynamics in research teams, needs to start with this distinction between integrative and complementary teams.
B. Methodological implications

The previous discussion of further research directions (with the use of case studies and agent-based modelling) is linked to some methodological implications and considerations coming from the current dissertation. In this section I want to elaborate on three methodological issues: the use of time-series analysis, the use of real-time data for the study of ICTs, and the use of different levels of analysis for the study of mutually-shaping processes.

Time series analysis was dictated for theoretical reasons, since the use of media in a local context and their interaction with that context were expected to change through time. Indeed, the analysis showed that the frequency of media use changed throughout time, and even the functions of the media in the case of ERICOM. This would have been easy to identify with a visual inspection of the distribution of the media variables. However, ARIMA analysis probes deeper in the behaviour of a variable, and reflects something essential (but generally neglected) for the social scientist: that often social behaviour has memory. This means that its present values will depend on its past values. A member going on vacation may result in a decrease of email frequency, but that would be corrected for, when this member returns. This represents the short-term memory of a past random shock, the moving average component of the ARIMA models. Further, twenty emails on Monday will probably result in many emails on Tuesday, since people will probably respond to these emails. This represents the memory that a variable has of its own previous value, the internal memory captured by the autoregressive component of the ARIMA model. This memory of social behaviour is something that is mostly ignored by methods of analysis.

Moreover, this memory has a pattern through time, which can be identified with an ARIMA model. The analysis of the two cases suggested that different components of the analysis may be related to different functions or processes of the media: the media whose frequency showed lack of memory were media with a formalised role and function in both teams. Furthermore, the media which performed different functions in different time periods (the two lists and the internal forum of ERICOM) were described by models with an integrated component. The integrated component, which reflects high sensitivity to random shocks (accumulation of shocks in time) was related to the lack of stabilisation of media configuration in the long run. It proved useful to reflect path dependence which is a vital aspect of complex systems. The use of the two lists and the internal forum, thus, were influenced to a great extent by random shocks because the media configuration in the team did not stabilise. Moreover, moving average models generally described the short-term influence of shocks. The use of the two lists in DELTA were only be influenced for one (or two weeks) by random shocks, because the media configuration in the team was rather stable.

Further, the different ARIMA models are for the first time linked to different types of complex dynamic systems. Stationary MA models, with negative MA coefficients, describe complex systems with low degree of complexity, one equilibrium point, and
negative feedbacks, which offsets the influence of random shocks in subsequent time periods. Non-stationary Integrated models, with positive coefficients, describe complex systems with high degree of complexity, multiple equilibria points, high degree of path dependence and positive feedbacks, which makes them far less predictable.

These insights constitute a novel contribution of the thesis to our understanding of the patterns that underlie the dynamic use of media in time, a topic hardly studied or theorised. Unfortunately there is no other study, to my knowledge, where ARIMA models were fit to the frequency of media use over time, in order to compare the results, with the exception of Hollanders and Vliegenthart (2008) who have applied ARIMA on news items. ARIMA models reflect also something fundamental in social sciences variables: that there are a number of random shocks, that is, unexplained disturbances that influence a variable over time. The search for causality (which variable causes another) may be less important than a systematic understanding of the different dynamic stages of a system. Also with respect to causality, the systems under study exhibited anticipatory activity: an activity at week t is caused by the expectation of an even at t+x. This anticipatory process, which most social systems exhibit, could be very well captured with cross-correlations and ARIMA modelling. In short, ARIMA analysis proved a very suitable method for studying complex social systems.

Time series analysis is a fruitful way forward, in order to understand the variations between media, and the underlying patterns which they follow, as their use evolves in a system. Time series analysis can provide, for instance, an interesting link between communication studies and innovation studies, and economics. It would enable us to compare the dynamic evolution of the use of different media, and understand how future media may evolve, or whether new media will be picked up in an already established communication environment or not.

However, apart from repeated measurements in time, time series analysis also requires careful methods of data collection, which relates to the issue of real-time data for the study of ICTs. ICTs give the possibility to the researcher to have a precise record of the behaviour under study: browsing, downloading and uploading activities online are systematically registered in the logfiles of the website with a set of additional information: time, date, duration of behaviour, IP address, type of browser etc; emails sent to a general list are saved in the central server. Understanding this data, collecting and analysing them require different skills and knowledge to those that communication researchers generally have: e.g. technical details of IP addresses, of time differences between emails and how they are recorded in a server, of how the data would be affected by a technical problem in a server. These skills and knowledge are necessary if we want to move away from studying what people think (and say) they did, to what people actually do.

But the use of real-time data does not only relate to the study of ICTs, to technical details and the use of quantitative analysis. As the current dissertation showed, the content of electronic communications, which constitutes also real-time data, is vital for our understanding of geographically distributed research collaborations. With most
communication between distributed researchers taking place via emails, activities such as
socialising, and conflicts (which are generally invisible to the researcher) now become
traceable. Real-time electronic data constitute important information for our
understanding of how new modes of collaboration function, instead of relying on how
people say they function. In this respect, ethical issues of accessing and using this data
for research are highly relevant.

The last issue relates to the study of mutually shaping, or co-evolving social processes.
The concept of information ecologies, and numerous studies in communication science
and science and technology studies discuss how the use of a communication technology
is always contextualised, and how social processes within that context shape and are
being shaped by the use of media. The conceptualisation of a complex system also points
to the intricate interrelations between variables at the local and global dynamics.
However, there are few studies which take this as a starting point and attempt to
analytically separate the social processes and the media use, and examine both directions
of their mutually shaping relationship at the same time. It is indeed very difficult to
analytically distinguish mutually-shaped phenomena, without resorting to pure
description, or pure abstraction.

In the current dissertation, the parallel study of how media configurations influence
processes of research collaboration and how processes of research collaboration influence
media configurations was made possible with a distinction between two levels of
analysis, and a distinction between methods of analysis: the former relationship was
studied with large-scale pattern identification and qualitative analysis at a more
aggregated level of analysis, looking at the differences among different media. Meanwhile, the latter relationship was studied at the level of weekly interactions, at a
lower level of analysis, looking at the functions that media support and the frequency of
media use. I believe that this is a fruitful approach which can improve our understanding
of how processes co-evolve and mutually shape each other. Conceptually, it implies that
the use of a medium at any given point in time always results from the communication
needs of a user in a given context. At the same time, the pattern of media use in a team
over time, the fact that the team uses more face-to-face meetings than email
communications, always influences the way team members interact with each other and
how they understand their collaboration. In this sense, by distinguishing the different
levels at which their dialectic relationship functions, we can understand the co-evolution
between the use of media and social processes such as research collaboration.
C. Theoretical reflections

The dissertation took as a starting point that working processes of research collaboration and the use of different media mutually shape each other in the context of a research team. In this section I would like to discuss the theoretical implications of the work, and mainly the concept of media configuration, the collaborative endeavours under study, and, returning to the introduction of the dissertation, the role of ICTs in research collaboration.

In chapter 1, the concept of media configuration was introduced, consisting of three different elements: the type of media used in a context, the functions the media support, and the frequency of media. The reason for the introduction of a new concept was not trivial: the analysis suggested that these three dimensions were important for the dynamics of collaboration, some more than others in different contexts. The type of media used, and their technical characteristics (e.g. degree of public-ness) made a difference in the resolution of conflicts, the decisions, and the type of output produced, as we saw. Moreover, the functions that media support may be different in different contexts, a strong suggestion against the technological determinism implied in statements such as “ICTs do away with pleasantries”. Finally, the frequency of media use helped identify how collaborative practices influenced media configuration.

A further important element was if and how these three dimensions changed in time: the functions that media supported remained stable in DELTA, and changed in different periods in ERICOM; the type of media used the most remained the same in DELTA in the long run, but changed in ERICOM; finally the frequency of most media was evenly distributed through the whole period in DELTA, whereas it exhibited sudden changes in ERICOM. These all contributed, as we saw, to a rather stable media configuration in one team, and a media configuration that changed in different periods in the other team. Therefore, all three elements were important in order to understand communication and collaboration patterns in the two teams.

To what degree are these elements interrelated? Does the type of medium used influence the frequency of media used? Or, is the stability of functions of a medium related to the stability of frequency of its use? The analysis did not give any answer for the first question, but suggested that it could be the case that the stability of these three elements in the long run may be connected: the frequency of the general list in ERICOM team may have been more sparse when it was used for functions unimportant to the team, whereas it may have been increased in a period when it was used for functions vital to the team. The analysis thus suggests that there may be a relationship between these three elements of media configuration, but further research would need to clarify this point.

The current dissertation took as a starting point that in a research team working processes of research collaboration and the use of different media mutually shape each other. The research teams under study displayed all the characteristics of contemporary collaborations described by Hackett (2005a): they were international, interdisciplinary,
episodic groups, functioning with contractual agreements between institutions, with the use of new technologies for collaboration (ICTs). But in which ways are they different from the traditional modes of collaboration discussed in chapter 2?

The working processes of research collaboration are still fundamentally the same. Solving problems together in a lab, or in virtual space, essentially entails making decisions together, disagreeing, exchanging jokes and wishes, fiddling together with data, producing results, writing reports. The way in which these elements interact with each other, for instance that decision-making processes always entail the risk of disagreement and conflict, is still the same in “traditional” and more recent forms of teamwork. What is different is that the number of combinations between these different elements has now increased. What Shinn (1982) described as discipline-specific configurations between social and cognitive organization of research, have now increased in variety. The way these elements are arranged and combined in recent forms of collaboration is perhaps less discipline-specific, or rather less discipline-prescribed. This does not mean that disciplinary differences do not still exist: even in the two cases analysed here discipline-related differences manifested themselves. It is rather that there are now more possible configurations between the social and the cognitive dimensions of research. Specific ways of taking decisions will always relate to specific styles of leadership, but in a collaborative project this may involve social scientists, as well as physicists and geophysicists. In this sense, we can understand what Compalov et al. (2002) mean when they suggest that the types of teamwork they identified cut across different disciplines (see chapter 2 section A).

Is this development, this heterogeneity of configurations of social and cognitive dimensions, related to the use of ICTs? To some extent yes, since these types of collaborations would have been impossible without ICTs. A collaborative project between seven local groups based in seven different cities (or different countries), with all partners writing a literature review, gathering and analysing the same data together would have been impossible forty years ago. Now these types of teamwork are increasing. However, this heterogeneity is also related to more general changes in research and knowledge production, of which ICTs are a part: the increasing involvement of non-scientists (researchers from industry, governments, NGOs etc) in the researching and the scientizing systems (Gibbons et al., 1994; Etzkowitz and Leydesdorff, 1997), the emergence and increasing importance of scientific intermediaries (Vasileiadou and van den Besselaar, 2006), and an increasing diversity and heterogeneity of how knowledge is produced (Heimeriks, 2005). Changes in the dynamics of conducting research, therefore, need to be understood within a broader context of transitions at the scientizing and politicking dimensions (Heimeriks and Vasileiadou, 2008).

The current dissertation showed, however, how elements of these transitions and changes are linked to new ways of conducting research, which are inseparable from the increasing use of ICTs. The main thesis of the dissertation is that conducting research with the use of ICTs can be understood as conducting research with an increasing variety of different types of interactions and media characteristics. In this way, we can understand the term ‘ICTs’ as incorporating different types of interactions, mediated and quasi-mediated
interactions, personal and more public, synchronous and asynchronous. It is rather these characteristics of media that “make the difference” between different media. Perhaps more important is the characteristic of connectivity that ICTs entail: that different types of interactions and different types of elements are now more connected than before. A website can incorporate mediated and quasi-mediated interactions, with different degrees of access and different time-space coordinates. It is this simultaneous variety of types of interactions that ICTs offer, which enable the heterogeneity of combinations between the social and cognitive dimensions of conducting research.

The starting point of the dissertation was that ICTs influence research collaboration insofar as they influence communication processes of research collaboration (see chapter 2, section A). This relates to what Shinn termed the social organization of research, and in this sense ICTs can be used for taking decisions, fighting and arguing, for socialising and expressing emotional support, for coordinating who does what and when. However, there is a second way in which ICTs influence research collaboration, and that is by transforming the cognitive organisation of research, the subject matter of research. ERICOM was exemplary of these changes, insofar as ICTs were used as data, as data collection and analysis tools, as types of output, and representations of the “world”. The use of ICTs as subject matter in ERICOM increased the variety and heterogeneity of output, allowing different possible configurations of output: different types of results with different choices of data, different methods of analysing the data, different selection mechanisms of data. The use of ICTs as data, data gathering tools, data analysis methods, data visualisation methods and types of output increased the variety of possible output. But this also increased task uncertainty in the team, since work procedures were more heterogeneous and task outcomes more uncertain. ERICOM faced higher task uncertainty and therefore risk, also because ICTs were its subject matter. This high task uncertainty is the other side of the coin of heterogeneity.

In comparison, in DELTA ICTs were used for the social organisation of the teamwork, as an everyday coordination mechanism: as tools to make decisions, solve arguments, struggle for power, socialise and tell jokes. The use of ICTs was extremely successful for coordinating activities and managing the research project and in this sense it provided a variety of tools, mechanisms and interactions which increased mutual dependence between team members. The management of the project was successful; the coordination mechanisms were tight; the deadlines were met. On the other hand, the number of publications of the team was low, with a focus on traditional literature reviews, and the degree of innovativeness of the results also low. In DELTA, there was a higher need of coordination of task outcomes, and an adherence to common standards such as the common, negotiated, research tools. The standardization of results and the limitation of the scope of topics is the other side of the coin of higher functional dependence and tight coordination.

In short, the use of ICTs as a subject matter, and its role in the cognitive dimension of research collaboration provides heterogeneity and consequently more freedom for the intellectual pursuits of the individual researcher, which is risky as a research strategy of a team. The use of ICTs for the social organisation of research enables coordination and the
emergence of shared identity for a team, which may result in low degree of innovativeness. Task uncertainty or mutual dependence? The use of ICTs can simultaneously provide more freedom and more control. What does this imply for research policy and for research management?
D. Policy implications

The character of the two cases, the fact that they both were FP project collaborations enables a discussion of the results in terms of policy implications. Framework Programme collaborations play an increasingly important role in research at a European level, and provide instruments with which the Commission interacts with the researching and the scientizing levels. Even though regulations about FP projects have somewhat changed from the Fifth to later Programmes, these changes do not address differences between projects that were emphasised by the analysis here. The character of the project, namely the extent to which a collaborative endeavour is complementary or integrative, is still not taken into account in the regulations for these collaborations.

The regulations of FP project collaborations have an impact on the research dynamics as suggested by the analysis: the Commission’s emphasis on interdisciplinarity is related to how innovative the results of the project will be, but it also adds a level of complexity to the team dynamics. The initial task allocation between the partners (a point of negotiations with the Commission) influences not only the media configuration, but also the team-wide coordination.

What is more important to understand, and what the dissertation showed, are the different patterns which emerge linking media configurations, types of coordination and types of outcome. This diversity in patterns makes institutional flexibility essential. The formalization of regulations of the projects creates problems for projects with different types of intended outcomes, and different types of partners. A complementary research project requires different coordination mechanisms to an integrative research project, and that in turn may lead to different types of problems. This is something that reviewers and project officers need to be aware of. A project with partners from different disciplines will have different dynamics to a project with partners from the same discipline but different specialties. The inclusion of partners from the users’ perspective (such as the inclusion of group 7 in ERICOM after the Commission’s suggestion) will create additional complexity, and may create problems, if coordination mechanisms are not specified. Therefore, there needs to be flexibility with respect to the regulations of the Framework Programmes towards different types of research projects: the contract negotiation mechanisms, the specifications of partners involved, the evaluation mechanisms, the regulations about deadlines cannot be the same for complementary and integrative types of projects. Applying the same highly formalised regulations to different types of projects does not create the best conditions for their development.

This diversity, and the flexibility of rules it requires, is also related to what type of projects the Commission supports, and what types of outcomes it enables. The managerial success of a research project does not always lead to innovative results, or a high level of output. These two are not contradictory, but they are not necessarily complementary either, as the research here showed. Regulations about coordination mechanisms, recommendations for professional project managers, specification of means of communication, formalization of rules and strict adherence to deadlines do not
necessarily support creativity, innovativeness and publications in top-journals. Given the importance of FP project collaborations for the socialisation and training of European researchers, as well as the increasing funds poured in the Framework Programmes, it is useful to re-examine the dynamics between the regulations imposed, their degree of formalization and the different possible outcomes of research projects.

Finally, flexibility in research governance structures might enable different types of European Research Areas to emerge, instead of constructing and imposing a top-down vision of ERA. In short, what type of knowledge production and ERA do we expect with the governance structures currently in place?