Summaries

English Summary

Social networks matter. The characteristics of social networks have consequences for outcomes (Burt, 2005; Coleman, 1988; Fleming et al., 2007; Granovetter, 1985). The precise mechanisms leading to network structures are less understood. In order to study the dynamics of social networks, the mechanisms through which networks emerge are examined, bringing us to a better understanding of how this process works. In this dissertation a number of generative mechanisms are identified as antecedents that lead to network structures. These generative mechanisms are said to have three roots:

(1) network-only factors;

(2) individual factors; and

(3) contextual factors.

These roots describe the origin of these networks mechanisms. The roles these generative roots play in the generation of network structures remain debated, with theories suggesting different modus operandi (Ahuja et al., 2012; Liben-Nowell and Kleinberg, 2007; Shumate and Contractor, 2013; Whithred et al., 2011). I argue context is overlooked, despite increasing evidence that the success of different network structures is contingent on different organizational processes (Battilana and Casciaro, 2012; Burt, 2000). In this research, I advance knowledge in the modi operandi of networks by specifying the role of contextual factors to explain the diverse network structures observed. To explore the role of context on social network dynamics I investigated the network structures from three perspectives:

(1) the success of individual network structures (Chapter 3);

(2) the patterns of generative mechanisms within networks (Chapter 4); and
(3) the tendency of interaction (Chapter 5).

In reviewing theory, I explained there is no existing framework that considers the interplay of contextual factors and individual factors in explaining network structures. Thus, I applied a theoretical framework using structuration theory for the conceptualization of current knowledge on the role of generative roots in the emergence of networks. I proposed using structuration to delineate the role of context on network structures and outlined a theoretical framework from the concept of duality. Duality is the interplay between rules and resources that explain the structures employed by individuals to realize an action (Giddens, 1984). I considered rules as contextual factors identified through policies as interplay with other a set of resources endogenous network factors and individual characteristics measured from previous network positions and attributes of the individual researcher to describe these differences in network structures.

In pursuing this exploration into the exogenous effect on dynamics, several methodological extensions were necessary. A mixed-methods network approach is taken to evaluate the effect that contextual factors, as moderating variables, have on emerging network structures. This question is explored in an academic setting, where scientific collaboration networks of Dutch Computer Science researchers are investigated (Chapter 2). Context was identified through the identification of a number of policies that attempted to steer publication within nine Dutch Computer Science departments. Scientific collaboration structures were measured through publication data, inferring collaboration through co-authorship. The success of the realized publications of the individual researchers was measured through raw delayed citation scores. I addressed this question in separate empirical studies presented in three chapters.

Three key findings emerged from this research:

(1) The policies of a professional tenure system and a publication target list within a department enhance the success of cohesive scientific collaboration networks of researchers (Chapter 3).

(2) The existence of a tenure system influences the generative roots that explain the emergence of these scientific collaboration network structures of a department (Chapter 4).

(3) Tendencies to collaborate can be explained by a common university affiliation (Chapter 5).

In Chapter 3 I investigated the effect of two departmental policies on the success of the individual network structures of Dutch Computer Science researchers. Scholars have long debated the benefits of constraint in networks the extent to which an actor’s alters are connected to each other; however, optimal network structures remain debated (Burt, 2005; Coleman, 1988; Granovetter, 1985). In an attempt to shed light on this puzzle, some studies have suggested that specific network structures provide benefits depending on the context of the networks.
(Battilana and Casciaro, 2012; Burt, 2000). Formal organizations, such as universities, often impose restrictions and create opportunities through policies that seek to guide behavior and outcomes. In an attempt to elucidate the role of these policies in influencing network structures and subsequent outcomes, I considered the following: which organizational policies influence networks such that individual performance improves?

This study provides clear support for a theory that stipulates the interaction of organizational policies on the success of network structures. Findings suggest that, depending on departmental policies, constraint plays different roles in the success of individual researchers’ scientific collaboration networks. The policies of a professional tenure system and a target list within a department enhance the success of cohesive ego networks scientific collaboration. These policies serve as a sort of herding mechanism, working to facilitate specific types of networks of researchers. These are distinct where success in a network with low constraint allows the researcher to bridge or manage a number of clusters of collaborators, compared to success in a network that is more cohesive (high constraint), where communication barriers are reduced. These findings contribute to the ongoing debate on constraint between the efficiency of structural holes and cohesive networks, through specifying the conditions under which specific networks are successful. This research confirms previous studies that argued that high constraint in networks is most effective for completing complex knowledge tasks.

In Chapter 4 I investigated the emergence of collaboration structures using a dynamic network model to compare the mechanisms within the departments. Current methods were outlined and I proposed an extension to the use of SIENA (Snijders et al., 2010), an actor-based simulation network model, to compare the effect of different contextual factors on network dynamics. I proposed to compare models in classifying how a set of contextual conditions as defined by the bounded network relates to roles of significant generative mechanisms. Findings showed the existence of these effects and the strength of the effects vary between the departments. Linking these distinctions back to the specific classifications of exogenous contextual factors I found patterns in the specific factors in particular departments with clear policies for attempting to steer outputs by way of a formalized tenure system and a publication list generated networks with tendencies for transitive ties as well as a negative likelihood to collaborate with researchers that occupied broker positions. Thus, a context with a policies such as professional tenure system and a publication target list display structures of a networks where researchers work in close collaboration. Thus, context explains the local social mechanisms that researchers undertake to undertake collaboration.

In the final empirical chapter, Chapter 5, I investigated the entire field of Dutch Computer Science to identify a possible effect from the institutional level in a mean-field model. Scalability issues were overcome in previous models through aggregation of individual nodes. Parameters are developed using a data-aware approach which combines empirical research from Social Science and standard inferential statistics to develop a population-specific model for exploring the dy-
ynamics of collaboration in science. Thus here the context is no longer a control or a boundary condition but an explanatory factor in explaining dynamics. Findings show that past collaborative partners of one institution plays a key role in how future collaborations unfold. With every publication with another institution the chance of collaborating with someone from the same institution increases.

In invoking the mean field model, a number of theoretical assumptions emerge. This is the theory of the field. Field theory itself is not new; Bourdieu (1998) wrote extensively on the concept, as understood within the social sciences. Exogenous factors limits the nature of an elements/actors behavior. Thus, in specifying how and when these shifts in behavior occur, we can identify the conditions under which the state of an element changes. Inversely, through the identification of contextual factors, we can identify the set of possible behaviors. Thus, elements that potentially shift have particular attributes that make them susceptible to the field effect. Thus further application of the mean field model needs to explore the implications for network theory in identifying the exogenous context factor as having a critical interplay as an explanatory variable in explaining dynamics. This research is a first step in that call.

**Implications**

The context under which researchers develop and maintain their scientific collaboration networks influence their success, the behaviors employed to realize these networks and the tendency to collaborate. Within knowledge-intensive activities such as scientific collaboration, policies that attempt to avoid uncertainty alter the way in which researchers realize publications via potential collaborators. When a department has an evaluation list and a tenure system, it provides certainty about evaluation criteria. I suggest that this leads to distinct networking strategies where those in departments with specifications focus on their local position and invest in cohesive teams; whereas those without a list or tenure track system, performance criteria are uncertain and researchers must position themselves more globally. Strategic position in one context requires a different network than in the other. Researchers are facilitated and/or restrained by these specific policies about output and thus strategize accordingly. A mix of policies yields, overall, lower performance than when policies are explicit, which perhaps identifies a type of uncertainty within the context and leads to more experimentation with potential co-authors. This evidence has implications not only for how we understand dynamics but also for identifying the conditions under which individuals can employ their networks in a specific manner towards a number of possible outcomes.

These findings also contribute to our knowledge about the specific effects of different contextual factors on network structures. They provide suggestive evidence about how departments and/or universities steer success not necessarily through physical or monetary resources but through policies that promote specific behaviors. Thus it is not necessarily that top ranked universities or de-
partment attract better researchers (Allison and Long, 1990), but rather that in order to remain within the department, given the stipulations, researchers employ specific behaviors to achieve collaboration; those that do not behave this way are effectively removed or leave. Resources of top-ranked academic units serve as a selection system for cultivating a specific end. If this serves as the case, then when we consider a more global view on collaboration, we should observe that a common affiliation plays a key role in how collaboration unfolds. Given that context can be seen as a dependency for social mechanisms, a number of implications can be garnered for current theories on network dynamics. Overall it brings to light the necessary further theoretical exploration of exogenous contextual factors in constraining and/or facilitating the emergence of other roots and ultimately structures.

Further, as proved in this research, the use of the mixed-method model was an appropriate, necessary and valid choice to explore various possible effects of context. Such a toolbox allowed me to provide a broad set of evidence at which to understand the potential effects of context. This study also contributes to growing knowledge on the development of mixed methods for studies investigating both context as an antecedent as a determinant to the emergence and success of social network structures in studying large social networks. Thus, it suggests that effects need to be investigated at multiple levels - the ego, the bounded, relatively small, organizational context most often explored in social science studies of networks and a more global field approach. This allows the exploration of the complete reach of effects in explaining network antecedents.

**Policy Implications**

Thus, organizational context is an important enabling or constraining condition in both the emergence of specific structures and the success of different network structures. The results from the current study suggest that knowledge intensive organizations (e.g., universities) have the means via policies to affect the success of collaboration networks among scientists. The findings that suggest that departments with both a tenure system and a publication list enhance the success of cohesive scientific collaboration networks. These policies outline a set of specifications that guide the behavior that researchers evoke to achieve publication through collaboration. This leads to distinct networking strategies where researchers in departments with specifications can focus on their local positions (i.e., within the department) and invest in cohesive teams, whereas those without a list or tenure track system, or with uncertain criteria, position themselves more globally.

These results are particularly important for individual scientists and universities. First, individual scientists can try to build their collaboration networks in accordance with the departmental policies. A first step in doing this is being aware of those you collaborate with, and also how you collaborate with others to realize publications. If you realize your publications with a core team, work to
facilitate their communication and be sure to insures injections of new knowledge to maximize knowledge exchange and success through publication. If you function as a broker between different groups of coauthors, that do not collaborate with each other through publication, be aware of how you share knowledge with the different groups, and reflect on your position given different constraints of projects.

Second, universities can build on the insights of this research by streamlining their policies for collaboration and evaluation. For example, if a department has a publication list and a tenure system, it might pay off to encourage ties between collaborators by building opportunities for these collaborators to meet more often. Conversely, if a department has neither publication list nor tenure system, it might be best for performance of individual researchers to promote and encourage contacts with new collaborators, through e.g. facilitating conference visits. Concluding, both universities and researcher will profit from more attention to the contingencies of the social networks that they are embedded.

The success of cohesive networks in departments with publication steering policies are vulnerable to the increasing scarcity and uncertainty of tenured research positions. This is a threat to the overall quality of both a discipline and science system. The effect of these policies come into question when the incentives of promotion from successful publications become limited or even nearly impossible. Policymakers should adhere to the importance of balancing relatively cheap, junior research positions through funding mechanisms, departmental reorganizations and the like where tenure becomes only achievable for the very few; with funding for longer term research projects, and permanent chairs to sustain a healthy system.

In addition, in regards to Dutch Computer Science as a field. Despite that conference proceedings comprise the largest share of publications and are also among the highest cited publications within computer science, they still remain often absent from commonly used indexes and formal reviews and evaluations by faculties and universities. This distinct communication practice is often misinterpreted as a way to publish low quality or findings of less theoretical or practical value; when in reality these proceedings are significant products that serve both as markers of the patterns of collaboration that researchers undertake to produce knowledge, as well as the attributed quality of knowledge. Evaluators should take note of the impact of evaluated knowledge outputs of multiple forms and the networks that researchers employ in developing scientific knowledge when considering candidates for positions, funding and reviewing quality.

**Conclusion**

The context under which researchers develop and maintain their scientific collaboration networks influence their success, the behaviors employed to realize these networks and the tendency to collaborate. This evidence has implications not only for how we understand dynamics but also for identifying the conditions
under which individuals can employ their networks in a specific manner towards a number of possible outcomes. This sheds new light on previous network research, in particular the large body of research that has solely selected networks as a boundary condition for investigating networking mechanisms. This is just the first evidence to suggest context as a determinant and as described in the discussion deserves further theoretical exploration for confirming these effects. Although, if it holds true it puts to question the validity of a number of findings. Particularly those of studies where mechanisms attributed singly to individuals are said to be the driving force we must consider the conditions under which these local mechanisms arose. Thus suggesting different modi operandi for explaining the emergence and success of network structures.

This research has made a contribution to theoretical, methodological and practical knowledge for understanding the role of context in network dynamics. This research is among the first to provide empirical evidence within the framework of structuration to consider how exogenous contextual factors act as determinants. The exploration of a mean field model, as well as the implementation of traditional social network analysis techniques, proved that context has an effect on networking behavior. Thus, in understanding social network dynamics, context truly matters.