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**Decentralization, Social Networks, and Organizational Learning**

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## **Decentralization, Social Networks, and Organizational Learning**

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### **Abstract:**

Research on the exploration and exploitation of knowledge in organizations suggests that the autonomy of subsidiaries or units encourages innovation. However, that same autonomy potentially discourages the exploitation of innovations through inter-unit communication – suggesting a tradeoff between innovation, associated with exploration, and communication, associated with exploitation. Analyzing data on the operational decisions of captains in the English East India Company, we find that high unit autonomy encourages the transfer of information via social networks, whereas centralization depresses the use of social networks. Further, the information transferred via social networks does make its way into the formal knowledge base of the firm.

### **Keywords:**

### **Jel codes:**

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### ***Introduction:***

Research on organizations has posited a tension between innovative capacity and firm-level integration expressed in the literature on exploration and exploitation. In this literature, centralization is often a means of integrating and coordinating intra-firm units. Social networks seem to offer a decentralized means of integration that may resolve the tension between innovation and integration when unit-autonomy is high. The positive impact of social networks is well-studied, but the bulk of research on social networks has focused on either the performance of individuals within firms or inter-firm networks; intra-firm networks and their organizational antecedents have received considerably less attention (see the relative time devoted to intra-firm networks in overviews of organizational network research: Powell 1990, Podolny and Page 1998, Brass et al. 2004). Here we look at the relationship between decentralized and centralized organizational forms, the use of social networks within a firm, and rates of organizational learning. We find that decentralization, i.e. high unit autonomy, is associated with social network use and that information transferred via social networks filters up to the firm's larger knowledge base. Thus decentralization encourages communication networks that, in turn, encourage organizational learning. This finding indicates that decentralized firms may transcend some aspects of the exploration-exploitation trade-off if informal and decentralized means of communication are present.

### ***The Exploration-Exploitation Dilemma:***

There is a large literature that considers the trade off between exploration and exploitation in organizations. Exploration is considered to be the introduction of new ideas or ways of doing things and exploitation is the process of refining and distributing knowledge or expertise that already exists within the firm. It is widely accepted that a trade-off exists between exploration and exploitation (March 1991, Park et al. 2002, Holmqvist 2004). One source of this trade-off is research allocation; however researchers have also identified another perhaps more

interesting source in the consequences of centralization versus decentralization. Increasing the autonomy of organizational subunits allows them to explore new ideas, but has been associated with decreased communication between units (Lawrence and Lorsch 1967, Galbraith and Nathanson 1978, pp. 63-89, Egelhoff 1988, Sorenson and Sorensen 2001). And decreasing communication has been seen as the key to increasing autonomy and innovative capacity (Bower and Christensen 1995: p. 52-3, Benner and Tushman 2003, O'Reilly and Tushman 2004, Fang, Lee, and Schilling 2010), through skunkworks for example. Thus innovation (i.e. exploration) and communication between those within the firm (i.e. the exploitation of existing knowledge) have been seen as opposing processes.

This catch-22 is found in both the empirical research and organizational theory. In James March's classic formulation of the exploration-exploitation problem, new, or unsocialized, employees enter an organization and bring new beliefs about the organization and its environment with them. The organization assimilates some of these new beliefs into the organizational code, composed of "procedures, norms, rules, and forms" (March 1991, p. 73). When individuals rapidly assimilate the organizational code – allowing them to quickly exploit the larger organizational knowledge base, they lose their unique beliefs. Since these beliefs were the means by which new information was introduced into the organizational code, rapid socialization of individuals (i.e. the exploitation of existing organizational knowledge) reduces the rate at which the organization explores information – thereby improving the overall knowledge base. Autonomy, in this case conceived of as low socialization, favors exploration, but at the expense of exploitation and the rapid transfer of information via the organizational code reduces exploration.<sup>1</sup>

Contingency theorists do not explicitly address the exploration-exploitation trade off. They do, however, associate decentralization with a reduced capacity to communicate information across the firm, suggesting the creation of various centralized mechanisms to integrate departments when operations are decentralized (Lawrence and Lorsch 1967, Galbraith

and Nathanson 1978, pp. 63-89). Even more clearly, information processing theory argues that centralization increases information-processing capacity, but reduces the autonomy of units (Egelhoff 1988).

In empirical research, Deborah Leonard-Barton (1992), shows that core-capabilities (successful routines for the exploitation of organizational knowledge) inhibit the development of new products by trapping individuals within unsuitable technical and cultural systems established around the existing areas of expertise. Sorensen and Stuart showed that older firms (with developed core-capabilities) are better at incremental improvements to existing technologies and worse at responding to new market demands through the development of new products (2001). Process-management, a method of increasing control over organizational routines, produces efficiency gains for organizations, but is associated with decreased innovation (Benner and Tushman 2002 2003, Henderson et al. 1998, Sterman, Repenning and Kofman 1997). And, Sorenson and Sorensen (2001) show that franchises, which have greater autonomy from the firm than centrally operated units, are more likely to innovate than units operating under traditional hierarchical governance, but they are less likely to produce innovations that will help other units and less likely to communicate these improvements to the rest of the firm. In sociological theory, these problems are reminiscent of the balance between individuality and groupness in the work of Georg Simmel and Emile Durkheim.

Although well-documented, these tensions may not be insuperable – at least at the organizational level. In the 90s, researchers advancing a decentralized model of multinational organization began to question the link between decentralization and decreasing communication. They found cases in which, rather than decreasing inter-firm communications, decentralization had no significant effect either way; instead the frequency of inter-unit meetings, teams, and visits to headquarters had the greatest effect on internal communications (Ghoshal, Korine, and Szulanski 1994). Tsai (2002) also found that frequency of interaction between sub-units increased the knowledge transfer between units.

Social networks are known to serve as information conduits (Podolny 2001); therefore they may assist in the knowledge transfer that is vital to the successful exploitation of knowledge within a firm. At the same time, their decentralized nature makes it less likely that network communications would decrease unit autonomy in the same way as the centralized transmission of information. Therefore social networks should not threaten innovation to the same extent as the centralized dissemination of knowledge.<sup>2</sup>

***The Case:***

We explore these relationships with the case of the English East India Company. Although historical, this case offers several advantages. First, the Company occupies an important place in development of economic theory, figuring prominently in the works of Adam Smith, David Ricardo, James Mill, John Stuart Mill, Thomas Mun, as well as others (Barber 1975). As such, further understanding the roots of the English Company's success should help shed new light on long-standing debates over the relative efficacy of monopoly organization versus free trade. Second, the long history of the Company means that it went through significant organizational shifts, specifically from a decentralized to an increasingly centralized organizational structure. This variation allows for the exploration of the relationship between decentralization, social networks, and organizational learning. The longitudinal nature of the data, covering 233 years, also means that we are able to capture not only the influence of one individual upon another and evaluate the outcome at a later point in time, we are also able to capture the longer process by which the organization incorporates information.

Third, the data has several unique advantages. We are able to locate when ships, which we treat as units, are exposed to information, and estimate the likelihood that the information will affect unit behavior. This means that the data is behavioral. Behavioral data is not subject to the many types of recall bias that plague survey research on network connections (Marsden 1990) and, in this case, reduces the number of assumptions that have to be made the content of the

information passed through network ties and the receptivity of individuals exposed to the information. Additionally, when the Company sailed to the East the passage of information, goods, and capital were consolidated along a small number of available channels. Today, multiple information networks, cellular, telephone, email, internet, personal, commercial, overlap and feed into each other. The number of potential channels for communication makes the analysis of network communications difficult to observe (Egelhoff 1982, p. 436, Ghoshal, Korine, Szulanski 1994). In the era of the East India Company, there was less complexity. The large commodity-carrying ships were also the principal conduits in the transmission of information throughout the region. Therefore, the records of the shipping network of the English capture a flow of goods, capital, persons, and information that can be transformed into an analytically tractable network that captures a large proportion of English interactions.<sup>3</sup>

In the analysis we are interested in firm-level outcomes, in particular the prevalence of social networks in the firm at different times in its organizational history and whether the information transmitted through those social networks filters into the knowledge base of the organization. In order to gauge the prevalence of social networks in the firm, we analyze the use of social networks by organizational sub-units. Therefore we use micro-level analysis of units' operational decisions in order to understand firm-level characteristics, i.e. the degree to which social networks are predominant. We find that when the organization granted its units high levels of autonomy, the use of social networks was increased, facilitating knowledge transfer between units and into the formal knowledge base of the firm. When unit autonomy was diminished, social network use decreased, along with organizational learning.

## **THEORY AND HYPOTHESES**

### ***Social Networks and Unit Autonomy:***

The term social network has come to mean many different things. In this paper we define social networks as informal relationships such as friendships or advice, distinguished from formal

organizational relations determined by workflow, resource exchange or personnel transfer (Brass, Galaskiewicz, Greve, Tsai 2004). By autonomy, we refer to the decision-making capacity of actors. Unless explicitly stated otherwise, we use centralization and decentralization to refer to the centralization of decision-making authority and decentralization to refer to the decentralization of decision-making authority, i.e. increased unit-autonomy.

Social networks are known to improve information transfer (Venaik, Midgley and Devinney 2005), but research regarding their antecedents is still in an early stage. Research on antecedents for interpersonal networks, i.e. informal social networks, has found positive effects for actor similarity, personality, physical proximity -- affected by workflow and location in hierarchical structure -- environmental shocks, and national culture (Brass et al. 2004). We believe that decentralization is another likely antecedent of social networks that operates at the level of the organization, rather than actor. Specifically we believe that the use of social networks to transmit valuable information is likely to increase in decentralized organizational contexts.

Social networks are an emergent feature of social life -- that is they naturally arise from interactions between individuals. When individuals are in contact with each other, they interact and form relationships; these relationships cumulate into social networks. The question then is not when will social networks form, since they are a regular feature of social life, but when will they be used to transmit information about local innovations that may benefit the firm.<sup>4</sup> Here is where we believe decentralization plays a potentially crucial role. Our discussion focuses on factors affecting how information is received. The credibility of a source is known to affect the likelihood that the information they provide will be acted upon or incorporated into practice by other actors (Hovland and Weiss 1951, Szulanski 2003). Decentralization both increases unit prestige and implicitly sanctions unit innovation (Bartlett and Ghoshal 1989: p. 126, Birkinshaw, Hood, Jonsson 1998, Ambos, Andersson, and Birkenshaw 2010). Prestige confers legitimacy; therefore the legitimacy of information received from units is likely to be much higher in



organizations with high unit autonomy, making it more likely that other units will act on that information.

Our first hypothesis is therefore: *Hypothesis 1: High-unit autonomy will increase the use of social networks for the transmission of commercially valuable information.* We also hypothesize the converse: *Hypothesis 2: Centralization of decision-making will reduce the use of social networks for the transmission of commercially valuable information.*

***Social networks and organizational learning in decentralized contexts:***

Decentralization has been linked to organizational learning through the structural reorganizations designed to optimize the balance between exploration and exploitation. However these organizational redesigns are often meant to limit communication, not decentralize it (Bower and Christensen 1995, Benner and Tushman 2003, O'Reilly and Tushman 2004, Fang, Lee, and Schilling 2010).

Social networks have also been linked with innovation (Darr, Argote, and Epple 1995). We therefore believe the decentralized communication of social networks may offer another path to resolving the exploration-exploitation dilemma for organizations. Our discussion regarding the relationship between social networks and organizational learning focuses on the potential value of information passed through social networks and the decreased leverage of any one individual participating in a distributed information network.

Social networks increase the number of sources of information for any one unit, decreasing the leverage of those alters holding or transmitting information (Burt 1992). Units are therefore exposed to multiple bits of information and may adjudicate between them. Through this testing process, the value of the information received through social networks is likely to increase over time. It is possible that headquarters will recognize the increasing value of this information over time and act to incorporate it into the organization's knowledge base. However, even valuable information may be viewed with suspicion by headquarters within certain organizational

contexts. In centralized firms, innovative subsidiaries may be viewed with distrust as potentially opportunistic actors (Birkinshaw, Hood, Jonsson 1998, Ambos, Andersson, and Birkenshaw 2010). Due to their distributed nature, networks deliver information from multiple units, thus reducing the leverage of any one information source relative to headquarters. Therefore firm headquarters is less likely to be threatened by this information in a decentralized context, and more likely to use it, even when units have high rates of prestige.

We therefore hypothesize that: *Hypothesis 3: In a decentralized context, the organization is more likely to adapt to its environment by incorporating new information transmitted through social networks.* We also hypothesize the converse: *Hypothesis 4: Centralization decreases the likelihood that an organization will incorporate new information transmitted through social networks.*

## **DATA AND METHODS**

### ***The English East India Company:***

The English East India Company was a large trading organization with monopoly privileges in England whose commercial history stretches over 233 years, from 1600 to 1833. During the course of its history, the Company began a landed empire in Britain, which was to become the base of the British Raj. Though a monopoly in Britain, in Asia it competed against a small number of similar European companies – the largest rival being the Dutch East India Company (*Vereenigde Oost-Indische Compagnie*) – and numerous Asian merchants, a number of who possessed resources comparable to the European national monopolies. Goods traded by these merchants and companies were numerous. They varied from the exotic, for example, diamonds, rose attar, and elephant tusks, to what we now consider mundane -- pepper, cotton, porcelain, and tea. The Company went to over 272 ports within the commercially vibrant world of the East.

The English East India Company was also known to be a haven for private trade during the first two centuries of its existence. One important form taken by the private trade was self-

interested trade undertaken by company employees during their time of employment. Captains pursuing their private trade would divert company ships from official business in order to pursue their own commercial interests (Adams 1996, Furber & Rocher 1997, Marshall 1993, Anderson, McCormick and Tollison 1983, Erikson & Bearman 2006).<sup>5</sup> For example, English Company officer John Barlow recorded in his journal the *sub rosa* trips his captain made to Goa, the Portuguese stronghold, in order to buy arrack for his own private trade (Barlow 1934). Such events were not unusual.<sup>6</sup> In other words captains had a high-degree of decision-making capacity within their organizational framework. In this period, we consider unit autonomy to have been very high.<sup>6</sup> Researchers have since come to realize that a significant synergy between the private trade of the employees and formal company operations helped the Company achieve its tremendous success (Furber 1948 1976, Furber & Rocher 1997, Marshall 1976 1993, Watson 1980, Erikson and Bearman 2006).

However, in 1757, English Company forces won what is known as the Battle of Plassey, defeating the Mughal Empire and giving the English Company control over a significant area of land for the first time. The company became a colonial as well as a commercial power. This shift brought with it a new source of revenue in the form of land and agricultural taxes.

The increased political power in England and Asia considerably strengthened the hand of the principals within the firm. They began to clamp down on the private trade as part of a larger attempt to centralize operations and reduce the decision-making capacity of captains (Furber & Rocher 1997, Marshall 1993, Chaudhuri 1965 1993). The managerial board launched new investigations into identifying effective means by which to control overseas operations (Cotton 1949). In 1776 the Honourable Board of Directors passed an act that strictly forbade deviations from the ordered routes and ordered captains that deviated to appear before a joint committee of Private Trade and Shipping to explain their actions (Cartwright 1788?). In this later period, we consider unit autonomy to have been significantly reduced.<sup>7</sup> This variation in organizational centralization allows us to examine the relationship between structural autonomy of subunits,

social networks, and the incorporation of new knowledge at the firm level. It is a single case, however, the collection of network data is generally resource intensive and boundary specification is problematic using other types of sampling schemes, so single case studies of this type are not uncommon (Krackhardt 1990, Wenpin and Goshal 1998, Tsai 2002).

**Data:**

The data for this research came from the print volume, *The Catalogue of the East India Company's Ships' Journals and Logs, 1600-1834* (Farrington 1999). This volume integrates information from the journals, logs, ledgers, imprest books, pay books, receipt books, absence books, company papers, and voluminous correspondence of the Company. The initial stage of the project involved the electronic transcription of the information pertaining to all voyages of the English Company, supplemented by the collection of geographic data for the 272 East-Indies ports visited (Milburne 1813, Stevens 1775). The result includes a complete list of the 1,480 ships (4,725 voyages) that were engaged in official English Company trade from 1601 to 1835 and geographic coordinates for all 272 ports. All ships list the trading season in which they were active and 99% include the intended destination. The captain of the ship is systematically listed and present in 95% of the voyages with ports recorded. 85% of the entries for voyages contain a complete set of ports visited.<sup>8</sup>

This list of ports is the key piece of information used for analysis, since it forms the basis of the evolution of the trade network – each trip between ports constitutes the creation of an edge in the network and travel to a new port adds a node – therefore we confirmed its accuracy. The British Library holds the original ships' logs in the India Office Records Collection. A stratified sample of 107 logs confirmed that the ports listed as destinations in Farrington (1999) were those recorded in the original logs: dates and ports were correct in all cases.

One may also question whether the purser and captain (the two officers usually responsible for maintaining the log and journal) recorded the actual passage of the ship. It is

possible that the captains and purser might omit ports from the logs that were not consistent with official orders and regulations – in order to hide transgressions from company officials. There is no evidence of such omissions. Instead, Portuguese and Dutch ports, legitimately off limits to English Company employees, are recorded in abundance. The practical reason for this honesty is that the log served as a navigational tool during the course of the voyage. The log tracked weather conditions as well as position. Without an accurate record, the ship would be lost, and therefore at risk.

The level of detail included in the data set allows a day-to-day recreation of the location of ships (through reference to arrival and destination ports), which spans 85,838 days – or 234 years -- from the granting of the royal charter, December 31, 1600, to the return of the last ship, the *General Palmer*, on March 3, 1835. The data captures both ‘networks,’ patterned interactions between individuals in different ports, and ‘flows,’ the movement of commodities, capital, people, and information (Castells 1966, Gotham 2006). It is the patterns of interactions between individuals that determine the subsequent ‘flow’ of goods, currency, news, and people.

### ***Statistical Model:***

Throughout the history of the firm, captains faced a similar situation once at sea. As each captain pulled up anchor, unfurled the ship’s sails, and drifted into tropical waters, they had several considerations to weigh. They were about to pilot a one thousand ton wooden ship into uncertain waters with a crew of one hundred or more men, half of whom may have been suffering from scurvy, malaria, or a host of other illnesses and parasites that drastically lowered the life expectancy of Europeans in the East (Cotton 1949).<sup>9</sup> The crew and the captain were interested in making their own fortunes. However, they had to pursue their ambitions within the framework of employment offered by the English Company.<sup>10</sup> The Company would not immediately know if the captain deviated from his route, but they would notice if that deviation caused the ship to arrive in England late. If the Company principals did notice, there was the potential for dismissal.

Given this, the captain had to decide where he might find a safe haven and good prospects for trade. It is reasonable to assume that captains were acting on information about viable commercial opportunities at ports. They had three potential sources of information: organizational knowledge, personal experience, and social networks. Our central question is whether the use of social networks within the firm, i.e. decentralized communication, varies with the centralization of control within the firm.

In order to analyze the effects of social networks, we treat the decision of a captain to travel from one port to another in the East as the unit of analysis. The captain's decision is operationalized in the data as the creation of a directed tie between two ports. A tie occurs in the trade network when a captain travels from one port to another. This tie is the dependent variable.

We began by assuming that when choosing his next port, a captain could in principle travel to any other of the 272 ports visited by English Company in the East. We then used a fixed-effects logit model to estimate how the probability of choosing a particular port deviates from a baseline probability as a function of social networks, formal orders, and personal experience. If having information about a particular port through social networks makes captains more likely than the baseline expectation that that port will be chosen, we expect that the coefficient for social networks will be positive and statistically significant.

The baseline probability, i.e., the fixed effect, includes components for the directed dyad, season, and time period. Including the directed dyad component controls for such time-invariant factors as the distance between two ports, the popularity of any given link between two ports, as well as prevailing winds and currents which might make the voyage in one direction easier than the other. For many commodities, the source locations are very stable and hence are effectively controlled for as well. The season component, defined as three-month periods, allows for regular variations in weather patterns, primarily monsoons and hurricanes. Finally, the period component allows the baseline to vary over time as the popularity of the ports grows and declines. We use periods of forty years, which roughly corresponds to the pace of change in terms of shifts in the

major commodities traded and hence to the factors for which we want to control. Shorter periods run the risk of controlling for exactly the short-term changes in port popularity that arise from formal orders, personal experience, and social networks. To check robustness, we also estimated the models with baseline probabilities based on periods of twenty, sixty, or eighty years and obtained broadly similar results.

It should be noted that if the baseline probability of a particular choice of next port is zero, i.e., if the port is never chosen as the next port from the current port in the current season and period, it drops out of the estimation. This means, for instance, that ports established after 1700 do not appear as viable alternatives in 1640. Ports appear in the choice sets only during time periods in which they are actually visited. We also estimated models where ports entered the choice sets five or ten years prior to first visit or first formal order to visit and exited the choice sets five or ten years after the last visit or last formal order to visit. The results were very similar, suggesting that the period component of the baseline probability is sufficient to control for the appearance and disappearance of ports.

***Variables:***

**Social Networks within the Firm.** East India Company ships came into regular contact with each other when docked at port. Historians have provided anecdotal evidence that informal networks were an important source of information within the English Company: “the official correspondence between the directors and the factories also had as its constant shadow an extensive network of private communications, both within India and between India and London.” (Ogborn 2007: 95). If informal relationships between employees were used to transfer information between ships, the opportunity to communicate came when English captains and crews shared the same harbor. English Company employees came into close personal contact with each other when sharing a common port. If the port had an English factory, the factory would serve as the living quarters for all Company employees. In most ports, English access to

social and residential life was restricted by the local government. The English, as well as most other foreign merchants, were consigned to merchant ghettos, called *natio*s. As a result, these factories became the center of English social life overseas (Cotton 1949), facilitating the collection and transfer of information. Therefore, each captain should have been able to access information about the ports visited by each of the other captains anchored or recently anchored at the same port.

The data systematically reports only arrival dates, so the exact overlap is unknown in most cases. The total number of completed trips over the history of the organization was 14,065. In 1,012 voyages additional notes in the data recorded the departure date of ships from one or more of the ports visited in the East Indies.<sup>11</sup> Out of a sample of 200 of these voyages, 72 trips had complete information. We used this information to estimate the time it took to travel between ports and the average stay in ports, which became the basis for our calculation of departure times.

If the factories provided a home away from home for the English overseas, residents of the factories should have been able to store information that could then be transferred from ship to ship without direct overlap. However, the information would have to be timely to be useful. We estimated that information stayed in ports for four months after the departure of a ship. The model results are robust to variations of this estimate.<sup>12</sup> A small number of voyages originated in Asia. In these cases we estimated that they gathered in the port four months prior to departure to make preparations.

Using the supplied arrival times and the imputed departure times, we can assess which captains had an opportunity to get information from other captains. If two captains were in a position to communicate information, we assumed that the captains received information about the most recent port the other ship had visited.<sup>13</sup> We coded the variable *Networks* as one for a dyad if a captain had just received information about the possible destination port and as zero otherwise.



**Captain's personal travel experience.** Captains also had access to the store of information they had accumulated through their own travels in the East. The disadvantage of personal experience is that it is limited when compared to the information available through social networks and also more likely to be out of date. On the other hand, personal experience may reflect trusting relationships across firm boundaries or a deep cultural knowledge of sites that cannot be transmitted to others.

In either case, personal experience is a potentially crucial source of information for captains that must be disentangled from information transmitted through peer networks. In a trade network such as this, information is not only transmitted through the network, *it traverses the network* as actors move from location to location. The personal experience variable *Experience* captures the movement of information as it is carried and accumulated by the individuals that traverse the network. It is recorded in the data as a binary variable: one if the destination port is part of a captain's past repertoire from past voyages, zero otherwise. Since captains rarely return to a port during one voyage (Erikson and Bearman, 2006), we exclude prior ports on the current voyage from personal experience.

**Formal organizational goals.** The captains were also presented with formal voyage targets, which they may or may not have used to direct the passage of their ships. If they were to abide by the terms of their contract, captains were obligated at some point in their voyage to journey to the destinations indicated by the board of directors.<sup>14</sup>

These destination ports were systematically recorded in the catalogue of ships' voyages (Farrington 1999). Destinations were occasionally vague. When an area was listed rather than a port, we supplied the site of the major English factory in that region. For example, if Bengal was listed, we supplied Calcutta as the formal destination of the voyage. Our reasoning was that imprecise directions are only possible when general knowledge is high; therefore, vague directions are only given if the most obvious answer is the correct one. If the listed destination was too imprecise, i.e. the East Indies, we did not replace it. We did, however, supplement the

recorded destinations with the list of major factories and ports known as intermediate docks for those factories (Surat, Benkulen, Hugli, Vizagapatam, Masulipatam, Diamond Harbour, Saugor, Second Bar, New Anchorage, Whampoa, Penang, Singapore, Johanna, Madras, Bombay, Calcutta). These were the centers of English Company administrative power in the East. Captains pursuing their own trade were unlikely to make undirected stops at these official ports, even when private trade had limited legitimacy during the late-seventeenth to early eighteenth centuries. Drawing from a sample of ships' logs, we found that, again, if a destination was uncommon, it was likely to be noted in the first pages of the logs. More common destinations, i.e. *Mumbai* and *Chennai*, could go unnoted although they were part of the official route intended for the ship by the board of directors. We use the variable *Formal* to indicate formal orders to travel to a port; one is a formal destination, and zero is not. Since additional information about a formal destination would be beside the point -- and captains would be more likely to have information about formal destinations because they were heavily trafficked -- this is an important control. We also consider the strength of formal orders to be linked to the centralization of communication within the firm.

**Port Popularity.** Ports varied in popularity, and popularity varied over time, meaning some ports were more popular in some periods than in others. Because we are interested in the exploitation of new knowledge within firms, we were particularly interested in the extent to which social networks brought less popular ports, that is ports that might have otherwise dropped out, into the network. To measure the nature of the ports visited through the different sources of information, we created an additional variable (*popularity*) defined as the number of times the target port was visited by any captain from any prior port in the prior twenty years.

**Periods in the life of the East India Company.** Finally we included two variables to represent the distinct phases of decentralization and centralization in the Company's history. As discussed earlier, a significant change occurred in 1757 when the company won the Battle of Plassey and gained control of Bengal. The Company shifted from a commercial operation to a

colonial power, increasingly strong ties with the British state were forged, and private trade regulations were altered – significantly decreasing unit autonomy. The variable *Decentralization* captures the years prior to 1757, and the variable *Centralization* covers the years from 1757 until the end of the firm.

## RESULTS

First we evaluate Hypotheses 1 and 2. In Table 1, we consider how the shift from a commercial to colonial organization in 1757 affected the sources of information used by captains. Model 1 presents a baseline model and Model 2 presents the main results.

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Table 1 about here  
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It is apparent from the baseline model that formal orders, and personal experience, social networks are highly significant. That is to say that if a captain had access to information about a port through social networks, they were more likely to travel to that port.<sup>15</sup> Model 2 includes interactions with the variables representing decentralized and centralized eras of organizational control.

Personal experience had a roughly consistent effect across these two periods -- showing that despite the change in organizational regimes, captains maintained the ability to direct their voyages. There is a slight increase in the point estimates of the coefficients, but they are not statistically different from each other. This point is important to our interpretation of the data. One could argue that centralization reduced the captains' opportunities to travel to different ports, thereby destroying the opportunity to act on social networks, but not necessarily the networks themselves. However, personal experience had a relatively stable impact on captain's decision across both time periods, indicating that opportunities to act remained within the scope of the captains' abilities. Even in periods of high organizational control, it was difficult to undermine the unique authority of the captain at sea on his own ship. Centralization did, however, depress

communication between captains -- thus destroying or diminishing the network of information that had shuttled innovative information about local markets into the hands of the firm. The delegitimation of the captain's explorations did not keep them from pursuing private investments, but it did keep them from communicating the information they received on these trips with others as well as with the firm's headquarters.

Unlike experience, the effect of social networks disappears completely during the colonial era, and the coefficients for the two periods are statistically different at the 5% level. Thus there is a clear break with the earlier period. Decentralized communications disappeared with the beginning of the colonial era and its concomitant centralization of control within the firm. These results support hypotheses 1 and 2.

Second, we evaluate hypotheses 3 and 4. First we consider whether social networks brought information about new ports into general circulation when the organization was decentralized. Then we show that information transmitted about ports via social networks filtered into the formal organizational base during periods of decentralization.

Figure 1 tracks the relationship between port popularity and source of information over the life of the company. We measure port popularity by the number of visits it received in the prior 20 years and on the Y-axis plot the average popularity of the ports visited in that period. The different graphs look at how the average port popularity varied by the source of information used in the captain's decision to visit that port. For instance, the formal-order graph plots, for each period, the average popularity of the ports that were visited because the captain was formally ordered to go to that particular port.

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Figure 1 about here  
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The results in Figure 1 provides some initial support for Hypothesis 3 and 4. It shows that social networks directed trade to less-well served ports, with the exception of the last period of the company's life. This period corresponds to the era of high centralization. Thus social

networks seemed to have had an expansionary effect on trade only in periods with high unit-autonomy, i.e. when decentralized.

We confirmed this finding with another statistical model also reported in Table 1. In Model 3, we consider whether social networks are associated with trade to more or less popular points -- i.e. are social networks a conduit for transmitting information gained through exploratory voyages. Here we use the variable *popularity*. The coefficient for port popularity interacted with social networks is negative and significant. Indeed, the estimated likelihood of visiting a port due to information carried by social networks is almost four times as large for a port with just one visitor in the last twenty years than for an average port. (Recall that there must be at least one other recent visit in order to transmit information via a social network.) This result suggests that social networks were most influential when bringing information about less popular ports – that is, when communicating new information.

We consider how the effect varies across centralized and decentralized organizational contexts using three-way interactions between information type (networks and experience), port popularity, and organizational period. The results show that the interaction between networks and port popularity is largest during the period of decentralization, thus providing support for hypotheses 3 and 4. The interaction between experience, port popularity and decentralization, on the other hand, only reaches significance in the period of centralization. This strongly suggests that although individuals were willing to rely upon their own experience to venture to ports off the beaten track during periods of centralization, that same centralization eroded the trust between individuals – thus dampening the transfer of information about lesser-known markets.

We also directly examine whether local knowledge transferred via social networks was incorporated into the broader knowledge base of the organization. In other words, we want to examine whether ports introduced by social networks were later included in formal orders.<sup>16</sup>

Figures 2 and 3 present the results of these analyses. During the decentralized period, 30% of the ports that were later formal organizational destinations were initially social network

ports, i.e. information about these ports first traveled through the company via social networks. In the period of centralization, this percentage shrinks to 7%.

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Figures 2 and 3 about here  
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These results indicate that information transmitted via social networks both became part of the general knowledge disseminated within the firm and were incorporated into the formal organizational knowledge at a higher rate during the period of organizational decentralization, supporting hypothesis 3 and 4.

Putting these results together gives us a more complete picture. Peer-to-peer communication within the organization was only active during the period of high unit-autonomy and led captains to exploit local sources of information and visit less popular ports. Over time, many ports visited initially through peer information became central to the trade network and part of the organizational knowledge base. We conclude that the evidence is consistent with our main thesis that high unit autonomy encourages the formation and use of social networks that transfer information between units as well as to the larger organizational knowledge base.

## **DISCUSSION**

In the English East India Company, captains used social networks to find information about trade opportunities and their use of social networks had direct consequences for the pattern by which the firm pursued trade. When social networks were active they expanded the portfolio of ports actively engaged in trade. The captains effectively used their autonomy to explore local opportunities, straying off established paths – but that autonomy also encouraged captains to transmit the information they gained on exploratory voyages to others in the firm. During the last decades of the organization's life, control was increasingly centralized, and social networks became ineffective. They had no significant impact on influencing captains' decision to travel to ports and their impact on the firm's knowledge base was greatly reduced. Our conclusion is that

in the English East India Company social networks were an effective mechanism for the exploitation of knowledge gathered within the firm when the firm was decentralized.

This case is however strongly defined by the fact that captains were in contact and therefore communication with each other whether the firm was decentralized or centralized. In contexts in which units or subsidiaries are isolated from each other and entirely dependent upon headquarters to install communication channels between units, centralization may, at least initially, be the only option for increasing integration. In fact we believe that it is likely that centralization and integration were theoretically conflated in early versions of the exploration and exploitation literature because research was conducted in contexts where units were relatively isolated from one another.

The large-scale decentralization of firms through the creation of multi-national structures took place in the context of global expansion. The decentralization of control that accompanied the creation of multi-divisional, multi-national organizational forms may have contributed to a lack of effective communication between units; however geographic and organizational expansion are likely to have a significantly negative effect on intra-firm communications. Therefore it is very possible that many of the integration problems associated with decentralization should be more properly assigned to problems caused by expansion. The best way to remedy this blind spot is through further research on decentralization's effect on integration and communication patterns in the context of organizational or geographic consolidation.

It is also true that this research only applies to organizations, that is to say, sites of social interaction that already possess some degree of centralization and coherence. It is extremely unlikely that social networks would have the same effect in a more radically decentralized context, such as markets or friendships. This is therefore an important scope condition for interpreting these results.

## ENDNOTES

<sup>1</sup> James March's longstanding theoretical interest in the problems of autonomy and integration can be traced to at least 1955 (March 1955).

<sup>2</sup> March's influential model excludes any possibility of peer interactions. Individuals learn from the code alone (March 1991: p. 75).

<sup>3</sup> By this we mean English-English interactions. Systematic data on Asian and Middle Eastern trading voyages is not available. There were also country voyages made by English traders that are not captured in any extant data.

<sup>4</sup> Given that subsidiaries must have some means by which they come into contact with one another for social networks to form.

<sup>5</sup> Other company employees also participated in the private trade. Factors (company merchants that resided in Asian ports) were particularly important. However, we are focusing on the effect of social networks on the captains' movements.

<sup>6</sup> It may seem unusual that the company would have continued to allow unofficial deviations from official voyages; however principal-agency problems were rife within all early-modern trading companies (Carlos 1992, Hejeebu 2005). Smuggling and corruption were endemic among employees working in life-threatening conditions long distances from their employers. Companies would either spend considerable effort in unsuccessfully policing private trade or give into allowances. The English Company was resource poor and took the latter route.

<sup>7</sup> Here, ships are considered units.

<sup>8</sup> Of the missing 724 voyages, 188 were terminated due to rotting, wreck, acts of aggression, and other misadventures.

<sup>9</sup> Roughly 35% of the men serving within the English Company in the East died while employed (Hejeebu 2005).

<sup>10</sup> We are referring to the captains of the East Indiamen. Toward the nineteenth century, it was possible for private individuals to engage in the country trade if they had the resources necessary to procure ships, etc. Hejeebu also shows that profits from the private trade are likely to have increased with time – as individuals gained more experience and local knowledge (2005), giving employees an larger stake in future employment.

<sup>11</sup> Port departure often replaced port arrival information.

<sup>12</sup> There was almost no change in results based on 3 and 5 months storage periods. Additional models available on request from authors.

<sup>13</sup> We also tested the models with the assumption that the captains shared information about all prior ports on the current voyage. The results were very similar, which suggests that timeliness of information was important.

<sup>14</sup> Directions to captains are often listed in the first pages of ships logs and appear scattered through the paperwork associated with each voyage, bound in separate volumes in the India Office Records division of the British Library in London.

<sup>15</sup> The differences in effect sizes, however, are notable. While social networks increase the likelihood of choosing a particular port by 12%, formal orders make the choice over nine times more likely than otherwise. The large effect of formal orders is to be expected as captains had to go to the ports they were ordered to if they wished to remain employed.

<sup>16</sup> Although social networks require a previous voyage to a port, some voyages – particularly initial voyages – are not associated with any of the information types we were able to capture. It is most likely that these were based on information gathered through social networks outside of the firm. These are the ports captured here as social network ports.



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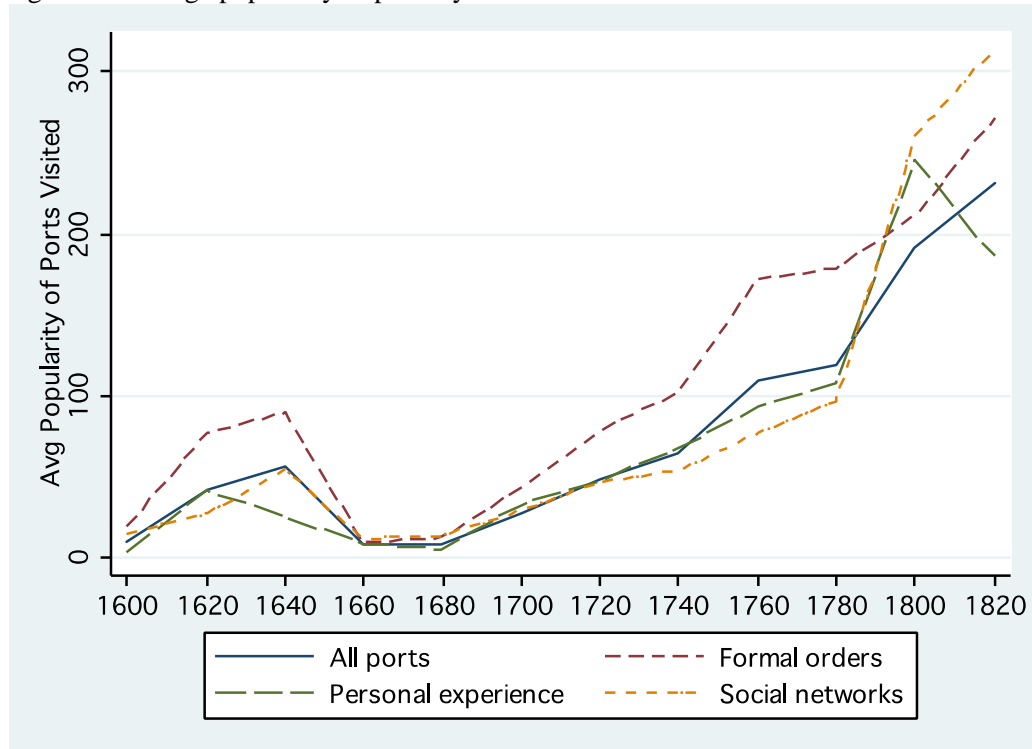
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Table 1: Effect of Information Sources on Choice of Port

	(1)	(2)	(3)	(4)
Tie				
Popularity	0.00421 <sup>***</sup>	0.00426 <sup>***</sup>	0.00557 <sup>***</sup>	0.00534 <sup>***</sup>
	(4.02)	(4.10)	(4.87)	(4.82)
Formal	2.266 <sup>***</sup>	2.263 <sup>***</sup>	2.516 <sup>***</sup>	2.274 <sup>***</sup>
	(17.82)	(17.77)	(15.83)	(17.96)
Experience	0.278 <sup>**</sup>		0.480 <sup>**</sup>	
	(5.33)		(6.48)	
Networks	0.114 <sup>**</sup>		0.355 <sup>***</sup>	
	(1.99)		(4.36)	
Experience Decentralization	x	0.223 <sup>***</sup>		0.374 <sup>***</sup>
		(3.36)		(3.43)
Experience Centralization	x	0.301 <sup>***</sup>		0.639 <sup>***</sup>
		(4.50)		(5.87)
Networks Decentralization	x	0.264 <sup>***</sup>		0.476 <sup>***</sup>
		(3.70)		(4.30)
Networks x Centralization		0.00319		0.287 <sup>**</sup>
		(0.04)		(2.18)
Formal x Popularity			-0.00200	
			(-1.54)	
Experience x Popularity			-0.00149 <sup>***</sup>	
			(-3.35)	
Networks x Popularity			-0.00246 <sup>***</sup>	
			(-3.33)	
Experience x Popularity x Decentralization				-0.00237
				(-1.63)
Experience x Popularity x Centralization				-0.00214 <sup>***</sup>
				(-3.93)
Networks x Popularity x Decentralization				-0.00433 <sup>**</sup>
				(-2.45)
Networks x Popularity x Centralization				-0.00209 <sup>**</sup>
				(-2.38)
Clusters	3241	3241	3241	3241
<i>N</i>	127959	127959	127959	127959

*t*-statistics in parentheses, fixed-effects logit estimates using directed-dyad-season-period fixed effects, standard errors robust to clustering on the fixed effects. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Figure 1: Average popularity of ports by source of information



*Note: Port popularity is the count of visits to the port in the prior 20 years. Past captain experience and social networks here excludes ports that were also formal orders and social networks excludes ports that were also personal experience.*

Fig 2: Organization's Formal Knowledge Base, Decentralization

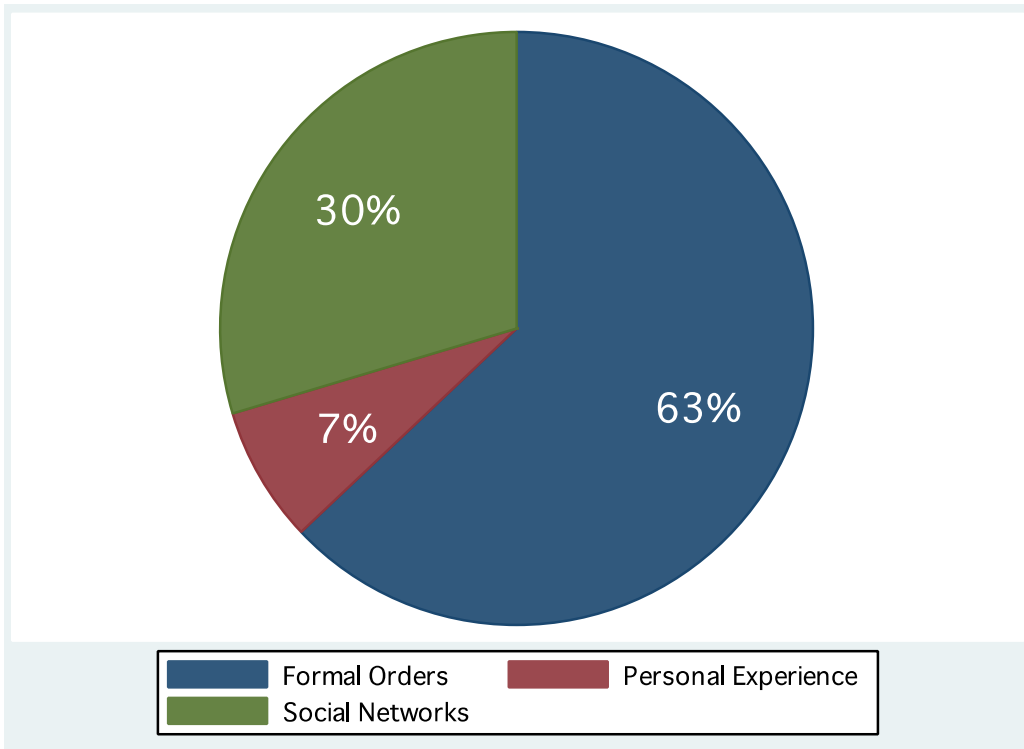


Fig 3: Formal Knowledge Base, Centralization

