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ORGANIZATIONAL PERFORMANCE OF A FIRM IN A MODULAR BUSINESS NETWORK

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Abstract

The organizational capabilities to interact with others have been greatly improved as a result of modern information and communications technologies: Nowadays a company can maintain more relationships with more companies at much lower costs than before. What impact does this increased interaction capability have on the company's choice to perform tasks itself or to 'outsource' such tasks to others (the trade-off between 'make' or 'buy')? Business network theory places the company in a 'business network', a web of business partners linked together in a flexible way to produce different outputs depending on the customer requirements. Previous research suggests that such business networks require modularization of the products, the processes and the firm in order to be effective. Firms would be able to share their core capabilities and therefore can respond faster, and more effectively, to different requirements. Are business networks indeed more dynamic and more 'agile' than other forms of inter-organizational co-operation like alliances, joint-ventures or markets? More precisely, what is the impact of the structure of a business network on the performance of the participating actor organizations? The objective of this study is to define and understand this relationship: business network structure and organizational performance. In this Research in Progress Paper we present our preliminary set of hypotheses and our testing instrument, a management game called the Business Networking Game that simulates modular business networks.

Keywords: Modular Business Network, Network Structure, Organizational Performance, Business Networking Game.

1 SCALE, SCOPE OR BOTH?

One of the fundamental debates in the academic world is about the boundary of the firm. This debate has revolved around the questions ‘where and how to draw the boundary of the firm’? The ‘where’ part of this question is often subdivided in ‘where to draw the vertical boundary of the firm’ hereafter referred to as the ‘scale question’ and ‘where to draw the horizontal boundary of the firm’ or the ‘scope question’. Firms are pressured to capitalize on scale advantages that exist in many industries. Scale advantages include economies of scale, increased bargaining power, setting standards and influencing governmental bodies (de Wit *et al.*, 1998). The scope question asks in which industries should a firm compete. One of the most often cited advantages of increasing the scope of a firm is that it allows for the realization of synergy effects. Practitioners and academics are still struggling with the scope and the scale questions. The answer to these questions has changed over time. The last century saw a rapid rise of the conglomerate and vertically integrated firm that reached its height in the 1970’s. Communication technology is becoming ubiquitous and therefore transaction and interaction costs are declining. This reduction in transaction costs lead to different ways of organizing the value chain, no longer is the conglomerate of vertically integrated firm superior but is being replaced by business networks. Firms that are part of such a business network can be seen as a portfolio of capabilities and relations, these capabilities can be utilized by the firm internally but can also be accessed by other firms in the business network. Modularity as an enabler of modular business networks is in more depth explained in the following paragraph.

2 MODULAR BUSINESS NETWORKS

Previous research suggests that such business networks require modularization of the products, the processes and the firm in order to be effective. This research is briefly summarized, after that we will move forward to introduce the theory of modular business networks.

2.1 Modularity

Modularity has been extensively researched in the last decade (Langlois *et al.*, 1992; Sanchez, 1995; Sanchez *et al.*, 2001; Sanchez *et al.*, 1996; Schilling, 2000; Schilling *et al.*, 2001; Ulrich, 1995; Worren *et al.*, 2002). Garud and Kumaraswamy (1995) define modularity as “modularity allows components to be produced separately and used interchangeably in different configurations without compromising system integrity”. Modular products tend to favor a modular organization form, for instance a modular business network because modular products are not designed and manufactured sequentially but concurrently and autonomously.

Following the research by the abovementioned theorists we propose that modularity as a design principle can be applied at four different levels.

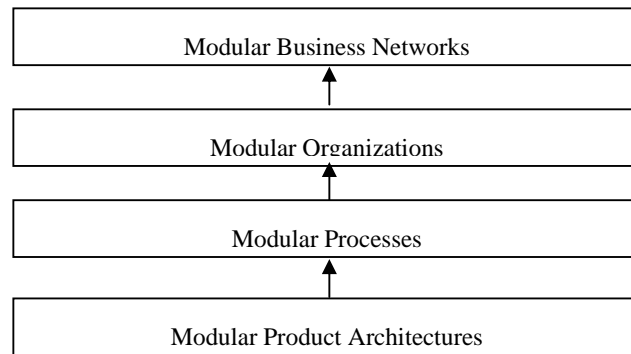


Figure 1 Illustration of the four levels of modularity.

Loosely coupled systems are defined as systems that are simultaneously distinctive and responsive. At the technological level the system is closed and at the institutional level the system is open to uncertainty (Orton *et al.*, 1990). Loosely coupled processes, or modular processes, have a specific task (e.g. distinctive); can easily be recombined with other processes (e.g. responsive). One of the direct effects of a loosely coupled system is that it exhibits modularity (Orton *et al.*, 1990). If loose coupling is applied at the organizational level this would enable modular organizations. According to Weick & Orton one of the organizational outcomes is adaptability (1990) defined as the ability to assimilate and accommodate change.

Sanchez (1995; Sanchez *et al.*, 1996) argues that *products design organizations*. Schilling *et al.* (2001) took that notion a step further by stating that “the loosely coupled organizational forms allow organizational components to be flexibly recombined into a variety of configurations, much as a modular product system enables multiple end-product configurations from a given set of components”. Thus, modular organizations would create modular business networks. Schilling *et al.* identify three types of modular organizations: contract manufacturers, alliances and alternative work arrangements. A modular product architecture does not restrict the organization to the unitary form with traditional firm boundaries, but allows it to disaggregate in a loosely coupled system of contracts (Schilling, 2000). Large parts of the manufacturing and R&D process can be outsourced to a network of simultaneously competing and collaborating firms that keep specializing themselves.

2.2 Modular Business Networks

According to network theorists critical assets (Dyer *et al.*, 1998), knowledge (Kogut, 2000) and capabilities are located in the inter-firm, or business network and not so much in the individual actor organization. According to Schilling (2001) “the locus of production is no [...] longer within the boundaries of a single firm, but occurs instead at the nexus of relationships between a variety of parties that contribute to the production function”. One of the key questions concerns the definition of the 'best' position in such a network. This depends on the structure of the network. Different network structures provide different ways of increasing the availability and access of critical resources while at the same time the uncertainty regarding those resources is reduced (Hite *et al.*, 2001).

Hoogeweegen (1997; 1999) introduced the Modular Business Network theory to design business networks utilizing electronic data interchange (EDI). A modular business network is a *network structure* whereby the actors that are part of that network structure have developed a quick-connect capability by which they can communicate and coordinate across the network structure. We define network structure as the *finite collection of actors and their directional ties* and *network roles* (Wasserman, 1994). Directional ties are one-way ties; a tie between actor A and actor B does not

imply that actor B has a tie with actor A. The ties directed towards actor A are called *incoming ties* and the ties leaving actor A are called *outgoing ties*. Each actor in a modular business network has a portfolio of capabilities and ties. This research will define a capability “as the socially complex routines that determine the efficiency with which firms physically transform inputs into outputs” (Collis, 1994). We define the network orchestrator as a particular network role whereby the actor has a relationship with the customer and is responsible for forming a temporary supply chain. Network role is defined in paragraph 3.1.

The network orchestrator receives the order of the customer as a set of service elements. Service elements ‘describe specific features of the total product and / or service range offered by an organization’ (Hoogeweegen, 1997). Before the temporary supply chain is formed, the network orchestrator translates the service elements of the order into production elements. Production elements can be seen as capabilities. Once the order has been translated into production elements, a decision is made which elements will be produced internally and which elements will be produced externally. The temporary supply chain is disbanded after the order has been fulfilled and the pool of firms is ready to produce new orders in new constellations.

A modular business network is able to offer both a high external versatility, - i.e. the range of products a company offers -, and be agile without disproportionate increases in the cost of serving customers. A higher level of product variety can be achieved through two mutual exclusive strategies, increasing internal versatility (internal production) increasing external versatility (outsourcing). Hoogeweegen (1997) refers to internal versatility as “the number of options available to produce specific products or services”. This trade-off, internal production or outsourcing, have different consequences for the portfolio of relations and capabilities of a firm. These consequences are the object of our research. According to Schilling *et al.* (2001) is a firm in a modular business network able to increase its scale flexibility, scope flexibility and its economies of scale by making this trade off between internal production and outsourcing.

3 DEFINING STRUCTURE OF A MODULAR BUSINESS NETWORK

Authors like Rowley *et al.* (2000) have argued that - depending on the environment - a different portfolio of strong and weak ties will lead to higher firm performance. In this research, we will extend their argument by including both role and position of an actor in a network structure, Rowley *et al.* (2000) did not include different *roles* in their research. The structure of a modular business network is captured by the construct “Actor in Network” which is a combination of two sub-constructs, “Actors’ position in a network” and “Actors’ role in a network”. These two sub-constructs are elaborated in paragraph 3.1 and 3.2 respectively.

3.1 Actors’ Role in the Network Structure

A role is defined as a “distinct technologically separable, value added activity undertaken by firms or individuals in a given business network” (Kambil *et al.*, 1994). The type of relationships and with whom an actor has in a business network determine what role that actor occupies. A particularly interesting role in business networks is the ‘network orchestrator’ as referred to hereafter.

According to Hinterhuber (2002) the network orchestrator has four roles: network architect, network judge, network developer and charismatic leader. The task of the network architect is to select member companies that make up the business network and to set objectives. The role of the network judge is to set performance standards to which the member companies of the business network must comply. The reason for this is that “the orchestrator remains the key interface for end customers and is thus fully accountable for the network output” (Hinterhuber, 2002). The third role, network developer, is to develop a network’s physical and non-material assets, including knowledge acquisition, knowledge transfer across the member firms and the creation of a strong brand image (Lorenzoni *et al.*, 1995). Lastly, the role of a network orchestrator is that of a charismatic leader, which should promote

admission of firms to the network and compliance with its rules. Furthermore, it should reduce strain on the network architect role.

The performance of individual actors in a business network will be dependent on the position - and therefore role - that it can take in that network. This again will be dependent on the structure of the network. It can be postulated that the relationship of any actor to the 'network orchestrator' will impact its own performance. Actors with strong ties with a network orchestrator are more likely to receive business from the network orchestrator because of the preferential status of that actor.

The number of firms making up a modular business network is larger than what Bakos (Bakos *et al.*, 1993) and Clemons (Clemons *et al.*, 1993) predict. However, this is not in contradiction with their insights. Because of modularization of the products and processes the number of suppliers will increase but the vis-à-vis competition within the modular business network will remain limited to a selected number of suppliers. The reason for this limited increase in competition is that suppliers will restrict the number of roles they perform in order to be able to clearly signal the way they add value in the business network.

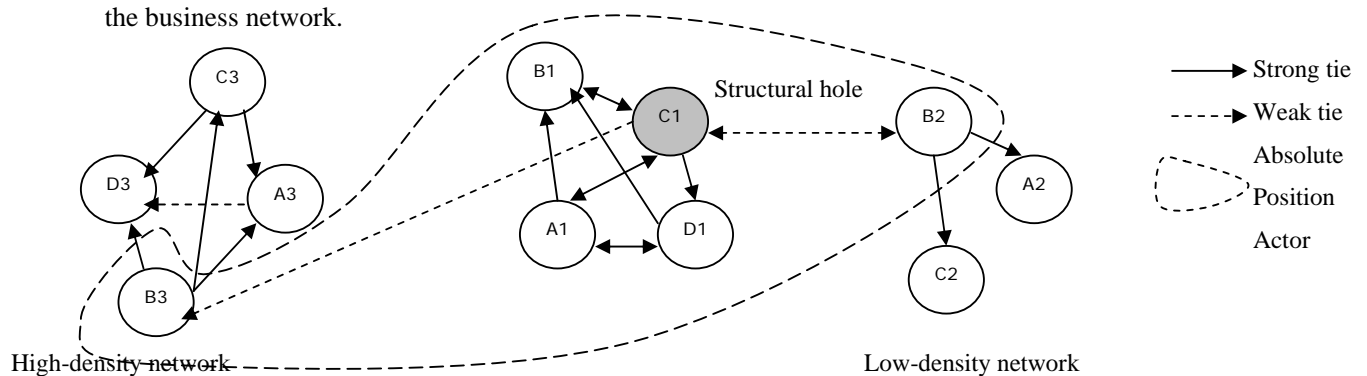


Figure 2 Illustration of weak ties, density and a structural hole

3.2 Actors' Position in the Network Structure

A network position refers to “a collection of actors who are similarly embedded in networks of relations” (Wasserman, 1994). We divide the “Actors' position in a network structure” construct in two separate constructs, the “Absolute position of the actor in a network structure” and the “Relative position of the actor in a network structure”. With the absolute position, we mean the position of an actor vis-à-vis the actors with whom it has *direct* ties. With the relative position, we mean how an actor is positioned within the total network structure. Whenever we refer to the absolute or relative position of an actor in a network structure, in both cases we do so from the perspective of an *individual actor*. For the purpose of this study the absolute position of an actor in a network structure is analyzed using the tie strength variable (Granovetter, 1973) and the structural hole variable (Burt, 1992). The relative position of an actor in a structure of a business network is analyzed using the following measures: density (Wasserman, 1994), centrality (Wasserman, 1994) and structural equivalence (Wasserman, 1994).

3.3 Defining Organizational Performance

As modular business networks develop as organizational form, one of the most critical questions will be what position an organization should aim for - and therefore what role that actor can play in the network. This positioning implies clear choices of the boundaries of the organization in scope and scale: the capabilities that the firm owns ('make' instead of 'buy') or chooses from its business partners ('buy', but from whom?), and the resulting organizational performance. For the purpose of this study we split organizational performance up in two separate constructs: *financial* and *customer*

performance. Customer and financial performance are seen as independent constructs for the purpose of this study, obviously they are related but it is outside the scope of this research to study this relationship.

We define financial performance as ‘company profitability’. Financial performance of an actor in a business network is measured using two metrics: the first one is *return on assets* (ROA) and the second one is *sales* measured in Euros. Return on assets is a performance indicator of an actor by the ratio of income to total assets. Sales is a performance indicator of an actor. We define customer performance as ‘the ability of an actor to fulfill a customer order on time, within budget of the customer and on quality’. Customer performance is measured using three metrics: the *average lead-time* to fulfill an order, the *customer profitability* and the product range, *external versatility*, the actor offers.

4 RESEARCH MODEL AND HYPOTHESES

The overall research question is formulated as: “What is the relationship between the structure of a modular business network and the organizational performance of individual actor organizations? And based on that understanding, how should an organization position itself in a modular business network?”

In order to answer this research question the following sub-questions are asked:

1. “What is a modular business network?” What is a business network structure and how can this be measured?
2. “What are the necessary conditions to create a modular business network?”
3. “How do you define and measure ‘performance’ of individual actors in a business network?”
4. “What influence has the network structure on the financial performance of an actor in a modular business network?”
5. “What influence has the network structure on the customer performance of an actor in a modular business network?”
6. “What are suitable positioning strategies for an actor in a modular business network?”

Paragraph 3.1 and 3.2 and the aforementioned research questions lead to the following research model which is presented in Figure 3. “Actor in network” is defined by “Actors’ position in the network structure” and “Actors’ role in the network structure”. The construct “Actors’ position in the network structure” separated by the “Absolute position” and the “Relative Position”.

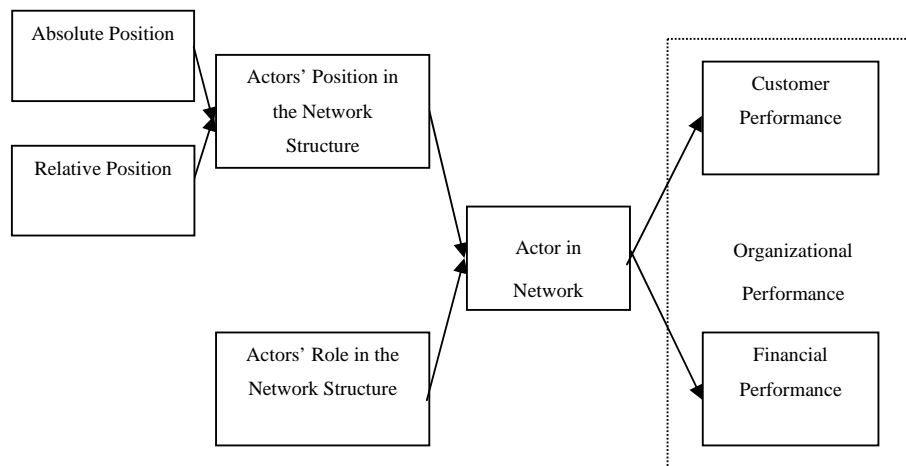


Figure 3 Research Model

4.1 Hypotheses

In this paragraph are the hypotheses presented that will be tested as part of this research. Due to space limitations are only the hypotheses presented that have as object the relationship between network structure and financial performance. The same hypotheses have been proposed for the relation between network structure and customer performance.

H1a: Network orchestrator actors will have (a) higher return on assets and / or (b) higher sales compared with other actors.

H1b: An actor that has a high level of internal versatility will have (a) worse performance on return on assets and / or (b) better on the sales compared with an actor that has a low level of internal versatility.

H2a: An actor with a high level of density will have (a) higher return on assets and / or (b) higher sales compared with an actor that has a low level of density.

H2b: An actor that has a high degree of betweenness centrality will have (a) higher return on assets and / or (b) higher sales compared with an actor that has a low degree of betweenness centrality.

H2c: An actor that has many weak ties will have (a) higher return on assets and / or (b) higher sales compared with an actor that has a few strong ties.

H2d: An actor that has a high structural equivalence will have (a) lower return on assets and / or (b) higher sales compared with an actor that has a low structural equivalence.

H2e: An actor who occupies one or more structural holes will have a (a) higher return on assets and / or (b) higher sales compared with actors who do not bridge structural holes.

The decisions made by the players, the type of investments they make, are being logged in a database. Using queries is this data exported to UCINET VI (Borgatti *et al.*, 2002) to test the hypotheses.

5 BUSINESS NETWORKING GAME

Larréché (1987) proposed the simulated environmental laboratory as concept for the use of role playing simulations for both educative and research purposes. We have developed such a simulated environmental laboratory, called the Business Networking Game (BNG). It is an experimental research tool for the simulation of modular business networks. Players are in control of a firm in a modular business network and have to pursue a strategy, through analysis of the decisions made we are able test specific hypotheses regarding network structure and organizational performance.

Dependent Variables as Decisions in the Business Networking Game	
Price policy	Investing in a new capability
Investing in a new business to business relationship	Specializing in an existing capability
Investing in a new market relationship 'business to business'	Dismantle a capability
Terminating a business to business relationship	Turn back a specialization of a capability
Terminating a market relationship	

Table 1 *Dependent Variables as Decisions in the Business Networking Game*

We have chosen the Dutch insurance industry to conduct our research because it is highly networked, especially between the intermediaries that sell the insurance policies and the insurance companies. Furthermore, it is an industry that uses modular products; many insurance policies are the combination of standard production elements. Finally, it is an industry that is in the process of developing 'quick-

connect' capabilities, integrating and standardizing process flows. These three characteristics make the Dutch insurance industry a suitable empirical environment to conduct this research.

The setting of the BNG is that of the insurance industry in the Netherlands. The objective of the game is to maximize your profit by positioning yourself in a favorable position in the network and developing a portfolio of capabilities and relationships. The game starts with three separate brands with each brand producing three different types of insurance products: car insurance, travel insurance and home insurance. The offered insurance products are modular, thirteen modular capabilities can be combined into 36 unique orders. To produce the different products a firm needs different capabilities, some capabilities reside in-house while others are available in the network. Depending on the starting position of a firm in the modular business network, each firm has its own portfolio of capabilities and relationships to start with. The first two brands consist of five business units and the third brand consist of four business units, it does not use an intermediary.

The Business Networking Game, see for an illustration Figure 4, is a turn-based game that is played in three rounds. As the game progresses each player has more freedom to determine the direction and speed of her strategy.

	Round 1	Round 2	Round 3
Strategic Speed	Fixed	Free	Free
Strategic Direction	Fixed	Fixed	Free

Table 2 Strategic Direction and Strategic Speed Freedom Increase While Playing the Business Networking Game

- Round 1 is used to familiarize the participants with the game and let them experiment with the user interface. Participants receive assignments that they have to execute and thereby learn what their position in the business network is and they have to practice three different strategies.
- In Round 2 the participants receive random a strategy with an operationalization. These strategy cards are based on Treacy and Wiersema's value disciplines; operational excellence, product leadership and customer intimacy (Treacy *et al.*, 1993). Depending on the strategy they receive, a player has to make investments in new capabilities, to specialize in capabilities already owned or to establish new relationships with other companies in the business network.
- In round 3 are the participants free to develop their own strategy and execute it, these strategies are usually based on the abovementioned strategy cards and on the feedback after round 2.

After round 2 and round 3 the performance of each firm is evaluated, the network structure is drawn and key performance indicators are given for each actor. Based on this information a group discussion is started to investigate why a certain firm wins or loses and what the relation is between network structure and organizational performance. At the end of round 3 is a survey distributed.

6 FUTURE DIRECTIONS

Currently, we are in the process of organizing twenty workshops for professionals and managers from a limited number of Dutch insurance firms about modular business networks. A consultancy firm has done the initial verification of the data; further validation of the data in the insurance scenario will be done using input from the participating insurance firms. Each workshop is expected to have twenty-five participants. The participants will experiment with different network strategies and the data gathered from these workshops will be used for scientific analysis and to test the proposed hypotheses from paragraph 4.1. The Business Networking Game version two has been finished and has been used in different graduate classes at a business school.

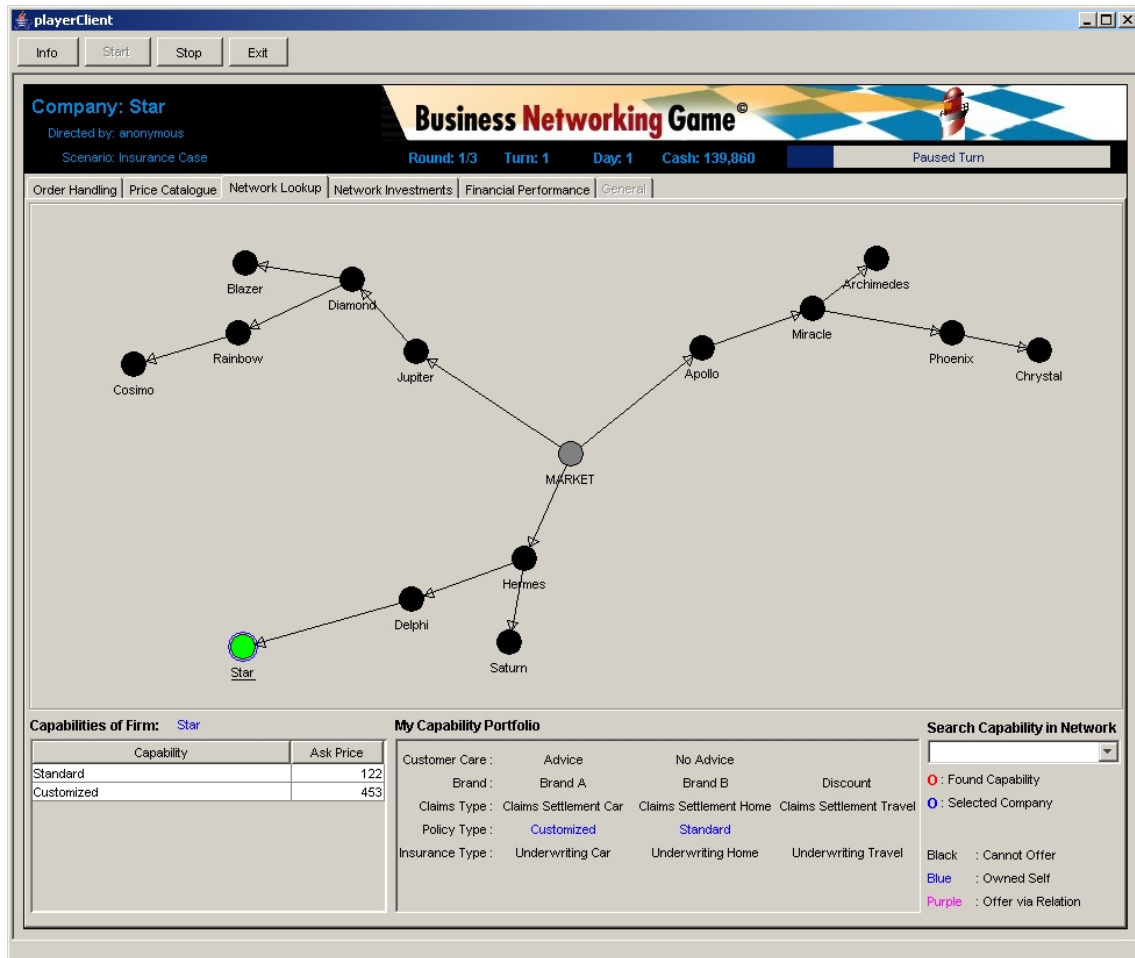


Figure 4 Screenshot from the Business Networking Game

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