A Business Simulation Game For Location-Based Strategies

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ABSTRACT

In light of increasing globalization, firms tend to move business functions to strategic regions around the globe to access and secure natural or human resources and benefit from potential agglomeration externalities. Moving business functions to specific locations is often a credible and visible strategic commitment that stimulates the firm's generic strategy. Therefore, it is an important concept for strategic management, which needs to be tightly aligned to the firm's corporate strategy. The formulation of a location- based strategy is built of consistent decisions about where and when to move specific business functions. The tradeoffs of these decisions are complex, interrelated, and dynamic. In order to teach and train location-based strategy formulation in an engaging, hands-on activity, this article describes the concept, learning outcomes, and architecture of a business simulation software program for moving specific firm functions to selected regions. It simulates an organizational lifecycle and agglomeration externalities such as knowledge spillovers resulting from labor pooling and specialized suppliers. The simulation is designed as a competitive group exercise for a course about location-based strategies in advanced business or management studies to engage students in a risk-free environment.

INTRODUCTION

In business and management education, courses about location-based strategies focus on the cause and effects of the regional, business-function-related, investment decisions of a firm. In light of increasing globalization, firms tend to optimize their economic activities by moving specific business functions to strategically aligned regions around the globe. Location choices for specific business functions depend on regional parameters such as access to labor (cost and quality dimensions), sophisticated infrastructure, density of specialized or diverse industries, and access to financial resources. This access to natural or human resources, which is location specific, fosters or hinders the success of a corporate strategy to gain a competitive advantage in either a direct or an indirect way (Alcacer & Chung, 2013).

In addition, the timing for making and implementing decisions depends on the organizational and industry lifecycles. Firms in the entrepreneurial state face a tradeoff between a relatively secure family-and-friend regional embeddedness and moving to more risky startup hubs in larger cities (Dahl & Sorenson, 2012). After entering the growth state of the organizational lifecycle, firms face the tradeoff between moving the research and development department to a specific location in order to benefit from agglomerated economies, such as knowledge spillovers, or keeping it separate to protect its intellectual property (Davis & Henderson, 2008). In later stages, when the firm is more established, multiple other factors, including proximity to customers and network effects such as labor pooling in production facilities, make the regional choice of specific business functions more important. Famous examples are low-cost textile industries moving production facilities to developing countries, information technology industries moving development facilities to emerging countries, and entrepreneurial firms shifting to specific innovation hubs in order to benefit from externalities like knowledge spillovers and labor pooling.

The academic theories that explain these externalities are the basis for establishing location-based concepts for strategic management to a align location decisions with the corporate strategy. A management course in business and management education that focuses on these concepts has two top-level teaching goals: a theoretical and a practical one. The theoretical part consists of concepts and cases regarding when and where to move a specific business function and the possible tradeoffs of these decisions. The practical part focuses on location-based strategy formulation, implementation, and alignment with the corporate strategy.

In order to complement the theoretical lecture with a practical activity, participants in business and management education typically participate in a business simulation game, which gives them the opportunity to experiment with strategy formulation and implementation as a way of training for such kinds of decision making, applying theoretical content in a risk-free environment, and experiencing the complexity of interrelated business functions (Faria, Hutchinson, Wellington, & Gold, 2009). This type of active learning element encourages active participation in class and critical thinking (Bonwell & Eison, 1991), and has a more sustainable effect on remembering learning outcomes than a passively consumed lecture (Coffey, Miller, & Feinstein, 2011). A similar setup can enhance the practically oriented learning outcomes of a location-based strategy course.

This article provides a description of a special issue business simulation game that focuses on the application of location-based strategies in an oligopolistic market throughout an entire organizational and industry lifecycle. In contrast to a full-fledged simulation, which implements various business functions to mimic the complexity of a firm, the proposed simulation focuses only on location-specific choices. Business function parameters such as production cost, quantity demanded, cost of labor, market price, and product value are subsumed in implications of the location choices for each firm's department. A firm (represented by a group of participants) begins in the entrepreneurial startup phase with an innovative product, a 3D printer. The goal of each firm is to maneuver the business throughout the organizational lifecycle and transform it into a multinational enterprise in competition with the other market players, just by deciding where, when, and how to locate and invest in certain business functions/departments.

The article is structured as follows. First, we discuss how a business simulation game can enhance a course on location-based strategies. Second, we define the various causes, effects, and tradeoffs of location-based decisions. The learning outcomes are defined based on the effects and tradeoffs. Third, an analytical description of the oligopolistic market model is presented, and, finally, an overview of the usage of the simulation software itself is provided.

USING A BUSINESS SIMULATION GAME AS AN ACTIVE LEARNING METHOD

Computerized business simulation games, sometimes called serious games (Abt, 1970), are simulations of economic models and business functions with gaming characteristics such as competition, leveling, or social interaction. Full-fledged business simulation games focus on representing a complete firm, with all relevant business function. The learning outcomes of this type of simulation game are oriented towards managing complex tasks and understanding the interplay of different business functions. Special-issue business simulation games concentrate on a specific aspect such as inventory management (Faria et al., 2009) or leadership development (Lopes, Fialho, Cunha, & Niveiros, 2013). Cognitive learning outcomes are narrowed down to the specific issues.

In education, business simulation games are used as an active learning method (Anderson & Lawton, 2009). Active learning is a didactic method that encourages participants to participate actively in class and fosters discussions and critical thinking (Bonwell & Eison, 1991). It has a more sustainable effect on learning outcomes than does frontal lecturing (Coffey et al., 2011). Currently, business universities often implement business simulation games in their curricula in addition to the case study approach for several reasons.

First, a business simulation game provides a risk-free environment in which participants can make decisions without facing fatal consequences (Popescu, Romero, & Usart, 2013), and, unlike with the study of case studies, the environment is responsive. Immediate feedback helps participants to adjust their actions and experience the consequences.

Second, the gaming character of a simulation implies the social aspect of competition and/or cooperation, which helps participants to understand the competitive landscape (Scherpereel, 2005). The emotional aspects of the experience and the social elements help participants to get a feeling of the complex interplay of business functions (Lean, Moizer, Towler, & Abbey, 2006).

Third, a business simulation game targets multiple learning objects (Mouaheb, Fahli, Moussetad, & Eljamali, 2012) that are not specifically related to topics in an individual course, such as decision making, teamwork, or out-of-the-box thinking. Anderson and Lawton (2009) group these learning outcomes into cognitive, behavioral, and emotional aspects.

Fourth, business simulation games are becoming a curriculum differentiator in terms of the use of information and communication technology at business universities (Glenn & D´agostino, 2008).

LOCATION-BASED STRATEGY EFFECTS AND LEARNING OUTCOMES

A location-based strategy is based on decisions often characterized as strategic commitments because its implications are visible and credible, and they reveal parts of the firm's corporate strategy. Therefore, the decisions related to such a strategy should be consistent and aligned with the overall generic and corporate strategy. Just like any other competitive strategy, location-based strategy includes the elements when, where, and how (with whom) to compete. This means a location based-strategy decision is defined as:

- a specific investment (move, build, upgrade, or downgrade) in
- a specific business function (administration/headquarters, production, research and development, sales and marketing)
- in a selected location (remote area, city, megacity), either domestic or international,
- at a specific point in time of the organizational lifecycle.

The effects of such a decision can be divided into organizational lifecycle effects, industry lifecycle effects, and agglomeration effects.

ORGANIZATIONAL AND INDUSTRY LIFECYCLE EFFECTS

Dahl and Sorenson (2012) analyze the performance implications for entrepreneurs (innovation phase) if they stay with friends and family or move to foreign locations. The local embeddedness of an entrepreneur at home offers easy access to financial resources, social security, less competition, lower infrastructure costs, and a well-known market, but the entrepreneur forgoes the opportunity to maximize income by moving to superior foreign economic regions. An entrepreneur can optimize resource allocation by moving away from friends and family. However, this comes at higher cost with more uncertain demand and less financial and social security. Firms in the entrepreneurial state, which focus on innovation, might have different location choices than established firms, which are focused on cost structure.

During the growth phase, firms typically expand production and set up new branches such as distribution and production facilities close to customers and suppliers. This is possible because these firms tend to be in a relatively good financial situation. In particular, it is easier for small and medium-sized enterprises or multinational enterprises to follow their customers' demand than it is for smaller firms in the startup phase. Specifically, when the firm reaches the growth phase or becomes established in the market, it gains popularity and might move to a larger city or industry-specific hub to benefit from agglomeration effects.

In addition to these organizational lifecycle effects, the industry lifecycle (innovation, growth, saturation, decline, and shakeout) influences department-location decisions in multiple ways (Keppler, 1997). Innovation activities are clustered during the innovation phase of the industry lifecycle and tend to disperse later, in the decline phase (Audretsch & Feldmann, 1996). This influences location decisions, because firms in a new industry are more likely to cluster regionally to increase tacit knowledge than are firms in later stages of the industry lifecycle, when each firm has its own knowledge capacity and can disperse to different innovation hubs or to protect its intellectual property.

After the saturation phase of the industry lifecycle, the firm's profits typically fall because of decreasing demand. In this situation, firms typically choose locations according to cost advantages (cost leader) or innovation advantages to raise the product value (differentiator).

AGGLOMERATION EFFECTS

Firms tend to collocate in specific regions in order to benefit from externalities in addition to accessing and securing regional resources. According to Marschall (1920), the primary externalities are labor pooling, specialized suppliers, and knowledge spillovers. While these positive externalities reduce overall production cost, the degree of benefit depends on the spatial and technical distances between the product (product industry affinity) and the region and its industries (location industry affinity).

Beaudry and Schiffauerova (2009) discuss the influence of specialization and diversification of industries on externalities and subsequently on product innovation and product cost. On the one hand, the Marshall-Arrow-Romer model (Glaeser, Kallal, Scheinkmann, & Shleifer, 1992) suggests that: (1) industry specialization within a region fosters knowledge spillover within the industry; (2) competition within the same industry fosters innovation; and (3) a cluster of similar firms and their suppliers supports labor pooling and economies of scale because of shared inputs and reduced transportation costs. The model by Jacobs (2009) on the other hand argues that innovation and cost reductions arise from an agglomeration of diversified industries. The analysis by Beaudry and Schiffauerova (2009) deliberately suggests that externalities based on the Marshall-Arrow-Romer model are more likely in regions with mature and low-tech industries, while Jacob externalities tend to be more likely in regions with high-tech industries.

Alcacer and Chung (2013) discuss the contribution of each firm to the primary externalities and the resulting implications. In particular, they focus on the incentive not to participate in certain agglomerated economies. They found that research and development and production facilities of larger firms contribute more to knowledge spillovers and result in lesser gains than those of smaller firms. This might lead, for example, to strategic avoidance of specific regions in order to secure corporate intellectual property. In contrast, a cluster of headquarters in specific locations fosters beneficial information exchange between the firm and its stakeholders such as customers, financial institutions, and governments (Davis & Henderson, 2008). The possibility of easy face-to-face interaction secures access to social and financial networks. This in turn comes at the cost of increasing wages, taxes, and infrastructure cost in larger cities, where firms tend to settle their headquarters (Davis & Henderson, 2008).

Agglomeration economies affect not only the firm's location parameters and business functions but also the region and industry; in particular, the effect depends on the size of the regional investment in a business function. Alcacer and Chung (2013) argue that the relative size of a firm is one of the main drivers for suppliers to locate and specialize close to their customers. In addition, quantitative and qualitative labor, a spatially scarce resource, is attracted by large agglomeration economies. Specifically, skilled labor is more attracted by the relative size of a firm than is unskilled labor. Similarly, large firms are more attracted by regions with a high percentage of suppliers, while smaller firms are attracted by regions with a large number of potential employees.

In summary, while agglomeration effects differ according to the type of externality, location parameters, business functions, and product portfolio, they are also self-reinforcing, which might lead to agglomerated economies in regions without any natural resources.

LEARNING OUTCOMES

Based on the described organizational lifecycle effects and agglomeration effects, learning outcomes can be formulated using the Anderson and Lawton (2009) categories of cognitive, behavioral, and attitudinal learning outcomes. The business simulation should sensitize participants for tradeoff decisions and help them gain experience with the interplay of network cause and effects (Lean et al., 2006) and strategy formulation. Participants should optimize the resource allocation of business functions with respect to location choices in order to maximize revenues and minimize costs in a competitive environment. In particular, the cognitive learning outcomes should be:

1. The (generic) corporate strategy determines the location-based strategy and vice versa.
2. A location-based strategy consists of various strategic commitments that act as signals to the market and imply a high degree of path dependency. This in turn makes the corporate strategy less flexible.
3. The organizational lifecycle influences the point in time at which firms generally tend to move specific business functions.
4. The interconnectivity cost of a firm, which is the cost to administer all business functions across all locations, increases with the number of different locations.
5. (Dis)similarity between product industry affinity and location industry affinity influences the benefit from agglomeration effects.
6. The size of an industry cluster influences the firm's cost factors such as wages and infrastructure cost and increases the economic value of the region by attracting specialized suppliers and more skilled and unskilled workers. However, excess demand for labor in a specific region leads to an increase in labor cost.
7. The benefit from externalities is influenced by several factors such as product-location industry (dis)similarity, the relative size of a firm within an industry cluster, or location parameters.
8. The relative size of a firm within a cluster determines the degree of its knowledge gain and drain (product innovation) and the benefit of labor pooling (product cost).
9. Specialized or diverse industry clusters influence externalities differently according to the location type (remote area, city, megacity).
10. Agglomeration effects are self-reinforcing.

The behavioral learning outcomes are (1) making decisions under time pressure, (2) working as a team, and (3) anticipating competitors' strategies. The attitudinal or emotional learning aspects are based on immediate feedback, given by the simulation, which helps participants to experience the cause and effects of decisions immediately without facing any fatal consequences (Popescu et al., 2013) and to understand the competitive landscape and the social aspect of competing with peers (Scherpereel, 2005).

THE SIMULATION MODEL

The story of the simulation revolves around four to six equal startup firms competing in the market of 3D printers, which is a homogeneous product at the outset. A firm owns the complete value chain starting with buying input material, assembling, improving, distributing, and marketing the product. The firms in this model do not produce any other products. Within five rounds, each firm's goal is to maximize cumulative profits by deciding, first, on a corporate strategy and, second, which business function should be moved at which time to a specific region.

A decision by one firm has several impacts: It influences (1) the firm's own revenue and cost structure, (2) the revenues and costs of other firms, and (3) regional economies, through the agglomeration of business functions, which in turn affects the decisions of all firms. All firms start with the same parameters. A firm decides in each round on a generic strategy: either to be a differentiator and improve the product or to be a cost leader and optimize its cost structure. While the price is fixed according to the generic strategy, a firm can influence its profits by optimizing department-location decisions: (1) to lower costs, (2) to increase the value of the product and increase demand, and (3) to increase the availability of the product and attract more customers.

The simulation is conducted in five rounds according to the industry lifecycle. Along with this industry lifecycle, participants are taken on a journey to grow their business from an entrepreneurial one to a multinational enterprise. In each round, the participants analyze their own firm's performance and the market situation. The participants obtain an economic forecast for each round, which describes how demand, specific costs, and regions will evolve in the upcoming round. Based on the given information, each firm $i = 1 \dots I$ formulates a location-based strategy as follows:

- Choose a generic strategy: $g \in GS = \{Differentiator \in \mathbb{R}^+, Costleader \in \mathbb{R}^+\}$
- Choose a location L_j from all available locations L, $j = 1 \dots J, J = |L|$.
- Choose a department/business function $b_{i,m}$ from all departments of firm i, B_i, or set up a new one b_i^{new}: $m = 1 \dots M_i, M_i = |B_i| + 1$.
- Choose an action step $a \in A = \{Create, Invest, Disinvest, Shutdown\}$ and an action step size $as \in AS = \{Small \in \mathbb{R}, Medium \in \mathbb{R}, Large \in \mathbb{R}\}$ for a specific department $b_{i,m}$ in a particular location L_j.

A department-location decision k of firm i is described by the tuple:

$$d_k \in D = L \times (B_i \cup b_i^{new}) \times A \times AS.$$

A location-based strategy s_r for round r consists of k decisions and the generic strategy g:

$$s_r \in LS = GS \times D^k$$

After setting up the location-based strategy, the participants can test it using a forecast tool. This tool calculates expected revenues and costs based on the firm's own strategy and assumptions about the decisions of all other firms. At some point (rounds are timed), each firm has to submit its strategy for the current round. The simulation takes all submissions into consideration and calculates the actual performance of each firm and changes in the location structure, and starts a new round with the next phase of the industry lifecycle.

Exhibit 3 shows the user perspective of the application flow of the location-based simulator. The simulation consists of five rounds. In each phase, a firm has to formulate a location-based strategy.

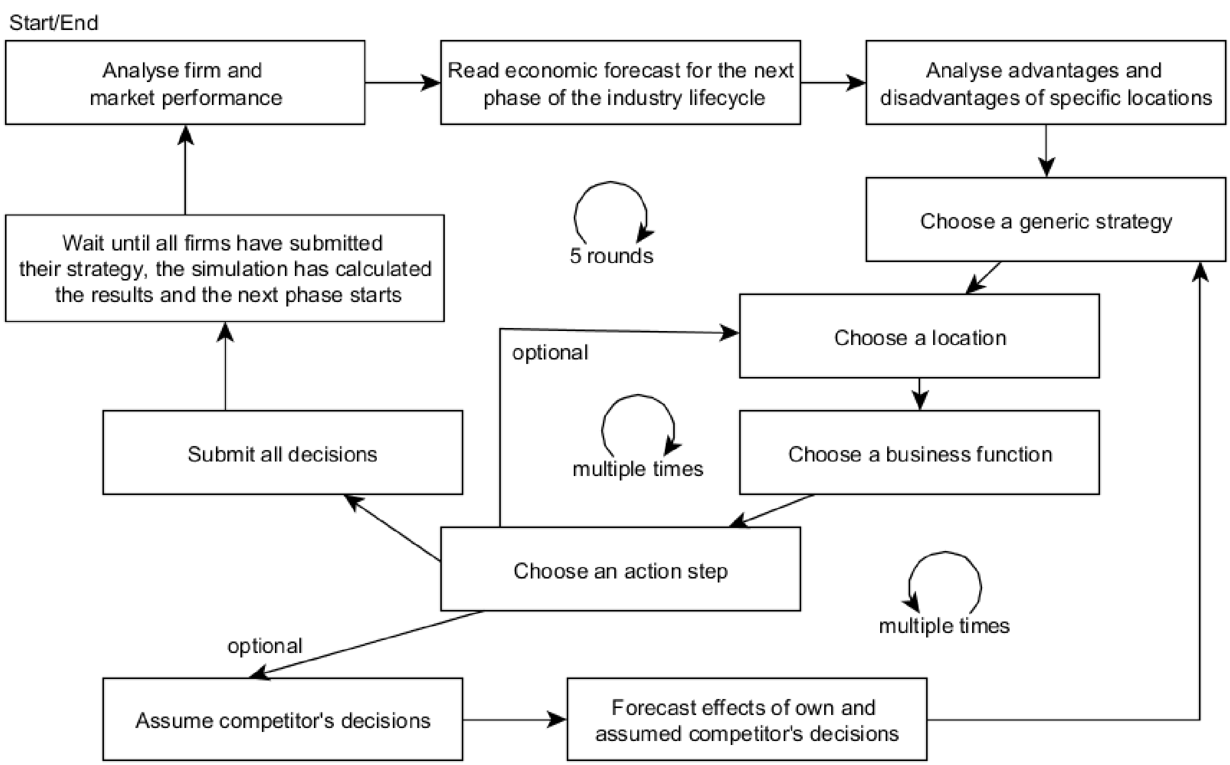
The submitted decisions in each round determine the revenues and costs of each firm, which translate into profits for the next round. For the next round, the participants obtain an economic forecast for the market as well as the decisions (not the actual performance) of the last round from all other firms.

In order to focus on the learning outcomes rather than on the complexity of maneuvering a firm, multiple simplifications about the firm structure, product factors, cost structure, location factors, department factors, and the industry lifecycle are defined.

FIRM STRUCTURE SIMPLIFICATIONS

A firm in this model consists of four business functions that unite several functions of Porter's generic value chain (Porter, 1985). Administration (AD) unites firm

Exhibit 1
Figure of the application flow of the business simulation



infrastructure, human resource management, and procurement. Research and development (R&D) maps to the technology development function of Porter's value chain. Sales and marketing (S&M) summarizes the functions of outbound logistics, service, and marketing and sales. The functions of inbound logistics and operations are represented by the production (PR) department. A firm can host numerous departments of the same type in different locations, except for the administration department. This mimics the headquarters status of the AD department. In each location, only one type of department is allowed regardless of its size. In order to avoid number crunching, only categorical sizes such as small, medium, and large are available. In the first round, a firm starts with one department of each type, and all are located in the same small region. This represents the entrepreneurship status of firm.

PRODUCT FACTOR SIMPLIFICATIONS

All firm tactics such as price setting, quantity setting, marketing expenses, research and development expenses, and so on, are substituted by indirect effects based on department-location decisions. The price for a product is determined by the generic strategy and cannot be changed. This helps participants to concentrate on the department-location decisions rather than using price tactics. Each firm faces its own demand function.

In order to attract more customers (increase the potential demand quantity), firms can improve the value of the 3D printer using three *product factors*:

1. The product awareness AW_i. The product awareness represents the degree of product popularity firm i achieves through marketing and sales and its relative dominance.
2. The product maturity and quality MQ_i serves as a factor to represent the perceived quality of the product of firm i.
3. The product innovation factor IN_i is used to represent the perceived added value for customers of firm i.

The potential demand quantity q_i^{PO} of firm i is defined by

$$q_i^{PO} = \alpha_1 \zeta(g) + \alpha_2 \cdot IN_i^* + \alpha_3 \cdot MQ_i^* + \alpha_4 \cdot AW_i^* + \frac{1}{I-1} \sum_{k=1,k\neq i}^{I} q_k^{US}$$

with balancing parameters $\alpha_1, \alpha_2, \alpha_3, \alpha_4 \in \mathbb{R}$. The generic strategy g of firm i is normalized by an inverse s-shaped function:

$$\zeta: S \to \mathbb{R}^+, \zeta(x) = \left(1 - \frac{a}{x} e^{\frac{b}{x}}\right)$$

$$a = 1$$

$$b = -1$$

The relative product factors of firm i are defined as follows:

$$AW_i^* = \eta\left(AW_i - \frac{1}{I}\sum_{i=1}^{I} AW_i\right)$$

$$MQ_i^* = \eta\left(MQ_i - \frac{1}{I}\sum_{i=1}^{I} MQ_i\right)$$

$$IN_i^* = \eta\left(IN_i - \frac{1}{I}\sum_{i=1}^{I} IN_i\right)$$

The relative product factors are normalized by an s-shaped curve η to represent diminishing marginal factor influence:

$$\eta: \mathbb{R}^+ \to \mathbb{R}^+$$

$$\eta(x) = \frac{1}{1 + ae^{bx}}$$

$$a = 20, b = -7.$$

The normalized relative product factors AW_i^*, MQ_i^*, and IN_i^* derive from the firm's own product factors minus the average product factors of all firms in the market. The sum of the relative product factors represents the perceived benefit by a customer if he/she evaluates all 3D printers from all firms. Larger relative product factors translate into larger potential quantity demanded.

The last element of the demand function adds the proportion of unused quantity q_k^{US} of all other firms in the market. The unused quantity q_i^{US} of firm i results from the difference of the potential demand q_i^{PO} minus the actual production quantity minus inventory.

The 3D printer itself is a product that uses materials from different suppliers. Therefore, it has a specific affinity for selected industries. In this model, a 3D printer depends on suppliers for chemicals, microcontrollers, chassis, design, and software. The model accounts for $n = 1 \dots N$different industries. The *product industry affinity vector* Φ_i^P of firm i is defined as follows:

$$\Phi_i^P = \left(\phi_{i,1}^P, \dots, \phi_{i,N}^P\right) \in [0 \dots 1]^N \text{ with } \sum_{n=1}^{N} \phi_{i,n}^P = 1$$

The tuple $\left(\phi_{i,1}^P, \dots, \phi_{i,N}^P\right)$ describes the degree of affinity of the 3D printer of firm i to industries $1 \dots N$. The product industry affinity vector is later used in conjunction with the location industry affinity vector to calculate externality effects. In addition, the product industry affinity vector is affected by the location industry vector, and vice versa. This models the situation of a product of a firm that moves departments to a region with a high degree of chemical industries; such a product is more influenced by these industries and evolves more around the chemical elements than on other components. In turn, a firm with a strong focus on software influences the industry affinity of the location regarding the software industry, which again in turn might attract other firms that are more software oriented to locate there as well.

COST FACTOR SIMPLIFICATIONS

The cost factors of a firm are split into two parts: periodical costs and investment cost. Periodical costs consist of three different cost types. The first type is that of unit costs and inventory costs, which scale according to produced and stored products. The second type is that of department costs such as maintenance cost, and the cost of white-collar and blue-collar workers, which scale according to the size, location, and number of departments. The third cost type is the interconnectivity cost, which is determined by the number of departments B_i multiplied by the average distance between all departments. Investment costs occur as a result of department-location decisions and depend on the action steps and action step size involved in the decision.

LOCATION FACTOR SIMPLIFICATIONS

Location L_j is described by simplifying it to the following characteristics:

- A pair of Cartesian coordinates (X_j, Y_j)
- An awareness factor AW_{L_j} and innovation factor IN_{L_j}, which influence the awareness and innovation factors of a firm settling in this location.
- The number $SP_{j,n} \in \mathbb{N}$ and average size $SP_{j,n}^{Size} \in AS$ of suppliers for each industry $n = 1 \ldots N$ in location L_j.
- The maintenance cost for each department type and size. The maintenance cost scales with the number of suppliers and firms active in this location.
- The investment cost for each department type, action step, and action step size. The investment cost scales with the number of suppliers and firms active in this location.
- White-collar and blue-collar worker costs and capacity. White-collar worker cost refers to employees in the AD and R&D departments, while blue-collar worker cost refers to S&M and PR. If the demand for labor, determined by the number and size of departments in a location, exceeds the supply, white-collar and blue-collar worker costs increase.
- The location industry affinity vector Φ^{L_j} for location L_j:

$$\Phi^{L_j} = \left(\phi_1^{L_j}, \ldots, \phi_N^{L_j}\right) \in [0 \ldots 1]^N \text{ with } \sum_{n=1}^{N} \phi_n^{L_j} = 1$$

Similar to the product industry affinity vector Φ_i^P of firm i, the location industry affinity vector Φ^{L_j} represents the composition of industries for location L_j.

DEPARTMENT FACTOR SIMPLIFICATIONS

A business function or department $b_{i,m} \in B_i$ of firm i is primarily characterized by its type $b_{i,m}^{Type}$, with $type \in \{AD, R\&D, S\&M, PR\}$ and $b_{i,m}^{Size} \in AS$. Type and size of a department determine the number of white-collar employees and blue-collar employees as well the production quantity q_i^{PR} of firm i (only for the production department).

While the location industry affinity vector affects the product affinity vector and vice versa, the number, type, and size of a firm's departments affect its product factors of awareness, maturity, and quality and innovation.

INDUSTRY LIFECYCLE EFFECTS

According to industry lifecycle phases, the model is disturbed by positive and negative shocks. Before the innovation phase starts, each firm gets, as an entrepreneur, a certain amount of capital to grow the business. In the growth phase, the overall demand for 3D printers increases. In the saturation phase, the demand stabilizes and each firm gets a bank loan to further expand the business. In the decline phase, the demand decreases, and in the final shakeout phase, the demand stabilizes at a lower level than before.

The economic upturn until the start of phase four ensures that firms can only reach bankruptcy after the decline phase. This helps participants to concentrate on optimizing the location-based strategy and aligning it with the firm's generic strategy, rather than worrying about bankruptcy. Because the overall goal of the competition element of this situation is to be the best among all participants based on resource allocation of business functions in terms of location choice, this model can be characterized as an optimization problem under uncertainty. Therefore, the metric of cumulative profits to determine the performance of each firm is used as a proxy to quantify the performance of resource allocation.

MODELING AGGLOMERATION EFFECTS

Agglomeration effects arise from situations in which firms concentrate regionally and influence each other without dedicated interaction. Such externalities based on spatial industry clusters are agglomeration effects such as knowledge spillovers, cost reduction resulting from labor pooling, specialized suppliers, or tacit knowledge. The metric to measure these effects is simplified into two concepts: *relative influence* and *industry affinity*.

The concept of relative influence represents the degree to which a firm benefits from agglomeration economies in a specific location. The relative influence is based on the number of departments a firm is running in a location multiplied by its department sizes in relation to the average number and size of the departments of all other active competitors and suppliers in the area across all industries:

$$IF^{*}_{i,j} = \frac{1}{M_{i,j}} \sum_{m=1}^{M_i} \kappa_{1,i}(j, b_{i,m}) - \frac{\frac{1}{I-1}\sum_{k=1,k\neq i}^{I}\left(\frac{1}{M_{k,j}}\sum_{w=1}^{M_k}\kappa_{1,k}(j,b_{k,w})\right) + \frac{1}{N}\sum_{n=1}^{N}(SP_{j,n}^{Size})}{2}$$

with $M_{i,j}$ as the total number of departments of firm i in location L_j and

$$\kappa_{1,i}: J \times B_i \to \mathbb{R}, \kappa_1(j, b_{i,m}) = \begin{cases} b_{i,m}^{Size} & \text{if department } b_{i,m} \text{ is active in location } L_j \\ 0 & \text{else} \end{cases}$$

as a support function to determine the size of department m of firm i, which resides in location L_j.

The concept of industry affinity represents the similarity between the industry composition of a product and the industry composition of a location. The distance δ between the product industry affinity vector and the location industry affinity vector using the distance measure:

$$\delta: [0 \ldots 1]^N \times [0 \ldots 1]^N \to \mathbb{R}, \delta(\Phi_i^P, \Phi^{L_j}) = \sqrt{\sum_{n=1}^{N}\left(\phi_{i,n}^P - \phi_n^{L_j}\right)^2}$$

retrieves the (dis)similarity between the product and the location. A small δ refers to a strong similarity, which transfers into agglomeration benefits based on specialization, such as a decrease in production cost. A relatively large δ signals dissimilarity between product and location industries, which indicates positive effects on innovation based on diversification.

Thus, the *relative influence* and *industry affinity* determine the actual influence of externality effects on a firm. How the externalities actually interplay with firms and locations is realized using the *product factors* and *industry affinity vectors*. While product factors influence demand, industry affinity vectors for product and location mutually stimulate themselves and change the product composition on the one hand and the industry landscape of a region on the other hand.

The location industry affinity in location L_j for industry n changes according to the average of relative numbers of suppliers for industry n and the average of affinities to industry n of all firms active in this location:

$$\phi_n^{L_j} = \frac{\frac{SP_{j,n}}{\frac{1}{N}\sum_{n=1}^{N}(SP_{j,n})} + \frac{\sum_{i=1}^{I}\kappa_2(\phi_{i,n}^P)}{I_j}}{2}$$

with I_j as the number of firms located in region L_j and the support function:

$$\kappa_2: \mathbb{R} \to \mathbb{R}, \kappa_2(\phi_{i,n}^P) = \begin{cases} \phi_{i,n}^P & \text{if firm } i \text{ is active in location } L_j \\ 0 & \text{else} \end{cases}$$

Simultaneously, the product industry affinity vector adapts to the location industry affinity vector, which is the average of all affinities for a specific industry across all locations in which the firm operates departments, weighted with the respective sizes of the departments.

$$\Phi_{i,n}^P = \frac{\sum_{j=1}^{J}\kappa_3(\phi_n^{L_j})}{J_i}$$

with J_i as the number of locations in which firm i is active and the support function:

$$\kappa_3: \mathbb{R} \to \mathbb{R}, \kappa_3\left(\phi_n^{L_j}\right) = \begin{cases} \phi_n^{L_j} & \text{if firm } i \text{ is active in location } L_j \\ 0 & \text{else} \end{cases}$$

Based on these metrics, the impact of a specific action step $a \in A$ and size $as \in AS$ for a department of firm i in location L_j can be determined for the firm's awareness factor, maturity and quality factor, innovation factor, unit cost, labor cost, and maintenance and investment cost. Each of these factors is influenc ed by the action step $a \in A$, size $as \in AS$, and the agglomeration effects.

ADMINISTRATION (AD) DEPARTMENT

A department-location decision of type AD influences AW_i by accounting for the relative influence $IF^{*}_{i,j}$ and the location-specific awareness factor AW_{L_j}. This mimics the fact that the awareness of a firm increases according to the location awareness, which is larger in megacities than in remote areas, and according to the relative influence of the firm in this location. The innovation factor IN_i of firm i is influenced by the location innovation factor IN_{L_j} and the distance between the product and industry affinity vector δ. A larger distance is interpreted as a beneficial innovation for the firm because of the diversity of industries. The maturity and quality factor is not influenced by a department decision of type AD.

On the cost side, the white-collar worker cost is influenced by the white-collar worker cost for the location, the relative influence $IF^{*}_{i,j}$, and the distance between the product and industry affinity vector δ. In this situation, a small δ represents cost benefits based on labor pooling because of industry specialization. The relative influence adds to the cost, because relatively larger firms in a region have typically higher costs than smaller firms. Beyond the included cost for the action steps and size, maintenance and investment cost incorporate only the relative influence $IF^{*}_{i,j}$ of firm i. Unit costs are not influenced by a department decision of type AD.

SALES AND MARKETING (S&M) DEPARTMENT

The S&M department is the primary choice for expanding the business across multiple regions and capturing demand abroad. Its intuitive function is similar to distribution points. Therefore, it only influences the awareness factor of a firm and incorporates the relative influence $IF_{i,j}^{*}$ and the location-specific awareness factor AW_{L_j} for the same reasons as does the AD department.

On the cost side, only the action steps, size, and relative influence $IF_{i,j}^{*}$ of firm i add to the maintenance and investment cost. All other factors and costs are not influenced by a department decision of type S&M.

RESEARCH AND DEVELOPMENT (R&D) DEPARTMENT

A department-location decision of type R&D influences only the innovation factor IN_i. The innovation factor is adjusted by the location innovation factor IN_{L_j}, the adjusted relative influence $c_1/IF_{i,j}^{*}, c_1 \in \mathbb{R}$, and the industry affinity distance δ.

This construct represents the influence of a location to the innovation factor, and larger δ means industry diversity between product and location, which leads to beneficial innovation. In addition, the adjusted relative influence $c_1/IF_{i,j}^{*}$ factor accounts for the fact that relatively large firms suffer from knowledge drain rather than knowledge gain. Smaller firms with a smaller relative influence will have a greater added value according to innovation in the presence of larger firms than occurs the other way around.

Unit costs are only influenced by the industry affinity distance δ. A larger distance translates into higher cost, whereas a smaller δ indicates specialization and lowers the unit cost. The impacts of a department location decision of type R&D on labor cost, maintenance, and investment cost are similar to those for the AD decision.

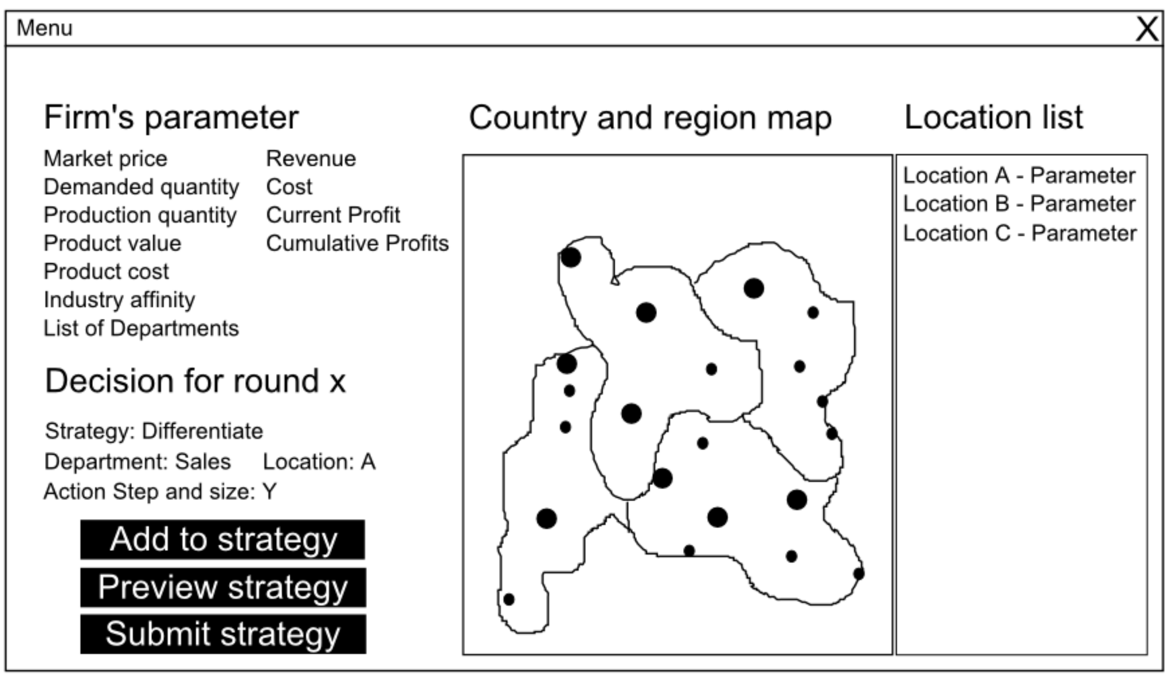
PRODUCTION (PR) DEPARTMENT

The maturity and quality factor of a firm is only influenced by department-location decisions of type PR. MQ_i accounts for the relative influence $IF_{i,j}^{*}$ and the adjusted industry affinity distance $c_2/\delta, c_2 \in \mathbb{R}$. The adjusted affinity distance mimics the concept that a high degree of specialization (small δ) leads to more quality-oriented production than does production located in an area with fewer similar industries. Other product factors are not influences by PR decisions.

Unit costs are only influenced by the industry affinity distance δ, with the same reasoning as stated for the R&D decision. The blue-collar labor cost is influenced by the blue-collar worker cost for the location, the relative influence $IF_{i,j}^{*}$, and the distance between the product and industry affinity vector δ. Again, a small δ represents cost benefits based on labor pooling because of industry specialization.

The impacts of a department location decision of type PR on maintenance and investment costs are similar to those for the AD decision.

EXHIBIT 2
FIGURE OF THE PARTICIPATION PANEL IN THE BUSINESS SIMULATION GAME



IMPLEMENTATION OF THE SIMULATION GAME

The simulator itself is a software program with a Web-based interface, which makes it accessible for most computer devices. The simulation consists of two interfaces: one for the instructor and one for the participants. While the instructor panel is used to fine-tune model parameters, the panel for the participants is designed as a cockpit view of a firm. This view, shown in exhibit 17, summarizes all necessary information for the participants on one screen. Location parameters are listed on the right side by hovering over a location. Firms and strategy parameters are displayed on the left side, and the country and region map shows available locations, own department locations, and competitors' department locations.

The business simulation game can be incorporated in the lecture in an alternate way (session, simulation period, session, simulation period …) or in a dedicated time slot. One period lasts about two to three hours, which cumulates to 10 to 15 hours. The time pressure of each round encourages participants to make decisions under imperfect information. In between rounds, the game can be enriched by including team strategy presentations.

SUMMARY AND FUTURE WORK

This article presents a business simulation game for location-based strategy formulation used as an active learning method in business and management education. A location-based strategy consists of corporate strategy aligned and consistent with department-location decisions, that is, where to move which business functions. Accessing and securing natural and human resources are clear incentives for a firm, but in times of increasing globalization, other factors such as organizational lifecycle effects and (self-reinforcing) agglomeration effects are important drivers, as well.

This special-issue simulation game is based on a model that allows students to focus on department-location decisions and optimize resource allocation in a competitive environment. The organizational lifecycle effects, agglomeration effects, and reinforcement mechanics are described analytically to showcase their interdependencies.

While the analytical model is set, the next steps arise around parameter sensitization and optimization, in order to address the responsiveness of the model. In addition, more elements such as corporate image or cultural diversity can be integrated to account for the costs and benefits of these factors. For example, moving the departments to several national and international locations increases the infrastructure cost but also the cultural diversity. This can be beneficial in terms of diversification or more costly in terms of adjusting process and communication standards.

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