RELATIONSHIP PRIORITIZATION FOR TECHNOLOGY COMMERCIALIZATION

Michael A. Danov,
Alexiev Transportation

J. Brock Smith,
University of Victoria

Ronald K. Mitchell,
University of Victoria

Drawing on stakeholder theory, network theory, and transaction cognition theory, a model is developed for determining the order in which classes of start-up stakeholder relationships should be developed. The stakeholder sequence model is then illustrated by application to a technology intensive start-up involving 'ground-effect machine (GEM)' technology. Knowing the efficient order in which relationships should be established is particularly important to entrepreneurs and managers leading technology intensive projects, as venture or project viability may depend greatly on the ability to cultivate the right stakeholder relationships at the right time. Implications are discussed.

Relationship management is recognized as being integral to business success (Wilson 1995) and a key source of competitive advantage (Day and Wensley 1983). It is particularly important in technology-intensive, start-up contexts, where effective commercialization requires relationships with multiple, diverse, and even multi-sector stakeholders, often on a national, if not global, scale. While considerable research attention has been given to the initiation and management of marketing and other stakeholder relationships, previous work has not addressed the question of the order in which key stakeholder relationships should be developed. This question is particularly important to technology based projects and start-ups. The viability of technology based ventures or projects may depend greatly on the ability of the entrepreneur or manager and his or her management team to attract key stakeholders at the right time. The equity generated and retained by the entrepreneur or manager likely also depends on his or her ability to cultivate key stakeholder relationships in an effective order. Greater equity might be raised in first level financing, for example, if an entrepreneur has already secured a lead user customer.

Drawing on concepts from stakeholder theory (e.g., Freeman 1984), network theory (e.g., Tichy, Tushman, and Fombrun 1974), and transaction cognition theory (Mitchell 2001a; Mitchell 2001b), we develop a model for determining the order in which classes of start-up stakeholder relationships should be developed. The stakeholder sequence model is then

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illustrated by application to a technology intensive start-up involving 'ground-effect machine (GEM)' technology.

BACKGROUND

Relationship marketing and the management of key stakeholder relationships have received considerable research and management attention. This attention is born out of recognition that relationship management is a key source of sustainable competitive advantage (Day and Wensley 1983). Strong relationships provide entry barriers, preferential access to scarce resources and markets, and customer loyalty-based cost and profit advantages. Relationship management is particularly important for the development of technology-based innovations (Mohr 2001). These innovations typically involve complex supplier, partner, distributor, customer, financial, regulatory, and other relationships – often in multi-sector and global contexts. This creates significant and unique relationship challenges (Bunn, Savage, and Holloway 2002), which is particularly true for new technology-based ventures that do not have established track records or established networks.

Relationship marketing researchers have focused primarily on issues relating to the initiation and management of: customer and buyer-seller relationships (e.g., Gaski 1984; Frazier, Speckman, and O'Neil 1988); channel relationships (e.g., Anderson and Narus 1990) and supplier relationships (e.g., Rink and Fox 1999; Steinman, Deshpande, and Farley 2000). Much of this work has focused on the dynamics and development of trust, communication, commitment, cooperation, relational bonds, and relationship quality (e.g., Anderson and Weitz 1989; Crosby, Evans, and Cowles 1990; Morgan and Hunt 1994; Smith and Barclay 1997), and the impact of constructs such as power, conflict, interdependence, and investments on the nature and development of these relationships – at the individual, dyad, or group (network or team) levels of analysis. The IMP Interaction Approach (e.g., Hakansson 1982), exchange theory (e.g., Homans 1961) and network theory (e.g., Thorelli 1986) provide conceptual and theoretical foundations for much of this work. Relationship marketing research has focused primarily on how to initiate and manage key relationships. It has not yet addressed the issue of the order in which relationships should be developed.

Stakeholder theory, however, does inform this issue. Stakeholder theory (e.g., Freeman 1984; Mitchell et al. 1997) is a set of concepts, constructs, and propositions that focuses on the identification, prioritization, and management of stakeholder relationships and an understanding of the environmental issues that bind them together. Mitchell et al. (1997), for example, suggest stakeholder salience can be prioritized by their possession or attributed possession of one, two, or all three of the attributes: power, legitimacy, and urgency. Stakeholder theory has just recently been applied in marketing contexts, such as: the development of radical new products (Cooper 2000); the design of green products (Polonsky and Ottman 1998), and ecological perspectives in marketing strategy (Polonsky 1995). Bunn, Savage, and Holloway (2002) apply stakeholder theory concepts in qualitative research designed to understand the development of stakeholder relationships in a multi-sector innovation context of a traffic management and emergency response system. This work is particularly notable since previous stakeholder work had focused on reactive responses to stakeholder demands rather than on proactive strategies to influence stakeholder relationships. Our focus on the order of relationship development also contributes to the development of proactive relationship strategies.

Network theory (e.g., Tushi, Tushman, and Fombrun 1974; Tjosvold and Weicker 1993) also informs our study of technology commercialization. Network theory suggests that organizations are defined by, and compete in, networks of cooperative, collaborative, and competitive relationships. Entrepreneurs, in particular, rely on informal and formal network relationships to establish and grow their businesses (e.g., Aldrich and Zimmer 1986) and entrepreneurial success has been linked to the ability of entrepreneurs to develop networks (Tjosvold and Weicker 1993). In the marketing literature, network theory underlies the concept of a market web (e.g., Ryans et al. 2000), a network specification tool aimed at identifying market chain (core value producing relationships), off-market chain (indirect value producing relationships), and knowledge-influence relationships (knowledge providers and users and advocacy or political relationships) of a focal organization. While researchers such as Rowley (1997) have investigated issues relating to the nature and structure of effective stakeholder networks, the issue of the order in which the relationships should be developed has not been addressed.

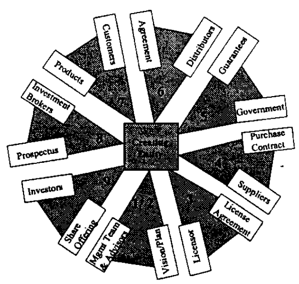
Finally, a new theoretical perspective in the entrepreneurship literature also informs the issue of proactive stakeholder relationship development. Transaction cognition theory (Mitchell 2001a, 2001b), integrates transaction cost theory (e.g., Williamson 1985), social cognition theory (Fiske and Taylor 1984), exchange theory (e.g., Homans 1961) and Austrian economics (Schumpeter 1934; Jacobsen 1992) to identify the cognitive processes required to complete a transaction - the most basic element of exchange (Mitchell 2001b: 7) and the building block of ventures, industries, and economies. Under the perspective of transaction cognition theory, entrepreneurship is the process of creating a series of transactions where a creating entity produces "work", something of value, for exchange with others. The work may be a vision and plan for exchange with management team "others", a good, or service, for exchange with customer "others", a prospectus and share offering for exchange with investor "others", or a purchase contract for exchange with supplier "others". Effective technology commercialization, then, requires identification of key stakeholder "others" and the ability of the entrepreneur or manager and his or her organization to produce the "work" desired by those others.

It also suggests that relational networks or market webs are created in, and might be specified as, a series of successive transactions. While transaction cognition theory does suggest the order in which cognitions are utilized to form exchange relationships (Mitchell 2001b: 89-90), it does not assist in the prioritization of the development of those relationships – which is the focus of our conceptual model.

A STAKEHOLDER SEQUENCE MODEL

The network theory concept of a market web, when integrated with transaction cognition theory, enables one to represent the generic transaction relationships that are necessary for a technology intensive start-up (Figure 1). This "relationship web" differs conceptually from the market web in that the market web focuses on specific parties and the nature of their relationships, while the relationship web captures the set of basic transactions required for the development and growth of a business.

FIGURE 1
GENERIC RELATIONSHIP WEB

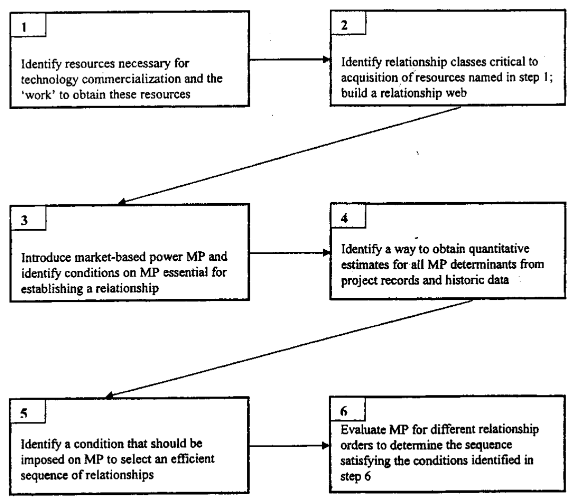


The relationship web identifies relationships at the macro level of analysis. It does not show a particular stakeholder but it implies that it is critical to develop relationships with at least one individual or organization within each transaction set or class. The related micro issue of which specific organization should be targeted for developing relational exchange is beyond the scope of this article. The stakeholder sequence model assesses relationships at a particular point in time. This is appropriate for the start-up context because relationships are clearly dynamic, and the state of the relationships changes over time. At start-up these relationships have not been initiated, and the decision of what order to enter into relationships is made at a single point in time (or in a sequence of points) with the information available at hand.

Drawing on transaction cognition theory, each triangle in Figure 1 represents a transaction where some type of "work" (output or process) is produced by a creating entity (entrepreneur or management team) for exchange with another stakeholder. Value is created and organizations grow through the replication of these basic transactions. The transactions represented in Figure 1 are not exhaustive, but were chosen to represent the critical (necessary and minimally sufficient) relationships and resources required to begin and run a project.

The stakeholder sequence model combines project-specific relationship web elements with a methodology to select the sequence ('Sequence Methodology') in which these relationship sets or classes should be developed. The process of developing the stakeholder sequence model involves several steps, which are illustrated in Figure 2. The stakeholder sequence model is subsequently applied to the commercialization of Ground Effect Machine (GEM) technology in which the lead author has extensive direct entrepreneurial experience. The stakeholder sequence model has application beyond technology commercialization relationships, but the model is particularly important and relevant for technology commercialization. This context requires management of many more diverse relationships, and the ultimate success of the commercialization and the value (profit) retained by the entrepreneur or innovating firm depends highly on the sequence in which key relationships are developed.

FIGURE 2
STEPS TO STAKEHOLDER SEQUENCE MODEL



Commercialization of technology-intensive opportunities usually requires a team of people with technology, engineering, production, legal, business, and other skills. Consequently, the first transaction typically involves an entrepreneur or technology expert (the creating entity) creating a vision and possibly a plan (the work) to recruit members of a management team and advisors (Figure 1: transaction 1/2). This group acts on behalf of the creating entity (shareholders) in subsequent transactions.

The nature of these subsequent transactions depends on the nature of the specific business and industry norms. However, technology-intensive start-ups typically involve creating: license agreements with licensors or government agencies (Figure 1: transaction 3); purchase contracts with suppliers (Figure 1: transaction 4); contracts, guarantees, or reports for government agencies; distribution and agency agreements with distributors and customer service providers; products for customers; business plans, executive summaries, or prospectus for investment brokers; and share offerings for investors. Other exchange relationships such as technology partnerships, production outsourcing, marketing alliances, or licensee relationships are also possible, as are more detailed specification of relationships, such as by types of customers or distribution channel.

Sequence Optimization

The order in which relationships of the relationship web are developed can affect the net value of the technology commercialization accrued to the new venture or project, and may affect whether it is viable as an ongoing entity. The challenge then, is to identify an efficient and effective sequence in which relationships should be developed. Although there may be other optimization goals, our focus is on identifying relationship sequences that minimize market-based power, the ratio of relationship investment and transaction value, while keeping it greater than or equal to unity, the value needed to complete a transaction.

If the creating entity's goal is achieving certain transaction values, the presented approach identifies a relationship sequence that can minimize expenditure of time, money, and other resources in developing the required exchange relationships. If the goal is maximizing transaction values, given a particular level of resources that the creating entity is willing to invest in building the relationships, the method identifies a sequence, which enables the creating entity to achieve maximum transaction values. In both of these cases, the resulting order is, therefore, the efficient sequence.

The described optimization goal may also be formulated in terms of risk and return tradeoff and can be illustrated by an example of relationships with the investor. Building relationships with other stakeholders (e.g., with customers) prior to establishing relationships with the investor increases the creating entity's risk (potential loss of this relationship investment) but results in an opportunity for the creating entity to increase its return because the investor's risk and uncertainty is reduced by the stronger customer relationships. In terms of risk and return, the objective is to minimize the ratio of risk and return for the creating entity. In a similar way the same optimization goal may be formulated in terms of cost and benefit tradeoff.

Market-based power

A solution to this optimization problem draws on the concept of market-based power. Stakeholder theory suggests that stakeholders can be prioritized by their possession of power, legitimacy, and urgency (Mitchell et al. 1997). Assuming that a creating entity's desire to establish exchange relationships with key "others" is both urgent and legitimate, as defined by Mitchell et al. (1997), the extent to which a stakeholder will entertain a proposal for an exchange relationship depends upon the power of the creating entity. While there are many sources and types of power (e.g., French and Raven 1960; Etzioni 1964), the most relevant type of power in this context is market-based power. Market-based power is the ability to affect decisions by other parties through market-based incentives – such as an attractive offer. Thus market based power is consistent with French and Raven's (1960) concept of reward power and Etzioni's (1964) concepts of utilitarian and normative powers – the ability to offer financial, resource, control, access, or other incentives that are more attractive than other offers in the marketplace. Exchange theory (e.g., Blau 1964) suggests that in order for an exchange to occur, the relative offers of the creating entity and the stakeholder need to be perceived as being attractive by both parties. These offers, however, may be based on different sources of power. Market-based power is an appropriate focal construct because it allows disparate offers to be compared. Because it is rooted in the exchange theory, the concept of market-based power is applicable only in contexts of voluntary exchange in market economies.

The effects of market-based power on the sequence in which relationship classes should be developed can be considered with an illustrative example of the problem of developing a relationship with the 'investor' (Figure 1: relationship 9) at the beginning of a project in technology commercialization. The market conditions of interest are related to the investment seed capital industry. If it is assumed that the supply of seed capital in a particular industry is abundant and the demand for the capital is lower than the supply, then, according to the notion of small numbers bargaining (Porter 1980), the market-based power of the venture capital companies and other investors is relatively low, and the market-based power of an entrepreneur with a quality project is relatively high. In this situation, an entrepreneur could expect to secure first round financing with a minimally attractive offer, without having developed other stakeholder relationships. This may be a rare, unusual situation, but projects do receive financing with just having what is perceived to be a good idea and a credible entrepreneur or venture team – such as many "dot coms" in the late 1990's.

If market conditions are opposite, i.e. demand for capital exceeds its supply, start-up companies will have to increase their market-based power (attractiveness of their offers) prior to establishing relationships with the investors. This might be accomplished, for example, by first developing relationships with lead customers or distributors. It may well be the case that all other relationships depicted in the relationship web should be developed prior to developing a relationship with the investors, in order to maximize the value of a share offering.

Sequence Methodology

Conceptual development of the sequence methodology involves several steps. These are depicted in Figure 2. The model itself is described below in more detail.

An exchange transaction will not take place unless the investors (or any other stakeholder) perceive that the value of the start-up's offer is greater than or equal to the value asked in return. Mathematically, superiority (inferiority) of an entrepreneur's market-based power to an investors' may be expressed as $MP_{ent} \geq MP_{inv0}$ $(MP_{ent} \leq MP_{inv0})$ or, equivalently, as:

$$\frac{MP_{ent}}{MP_{inv0}} \geq 1 \quad \text{(a)} \qquad \left(\frac{MP_{ent}}{MP_{inv0}} \leq 1 \right) \text{(b)} \qquad (1)$$

Where MP_{ent} and MP_{inv0} are the entrepreneur's and investor's market-based powers. The investor's market-based power is considered *constant* because there is no 'absolute' market-based power. An entrepreneur's power is expressed in terms of the investor's power because the entrepreneur typically makes an offer that the investor accepts or rejects. An entrepreneur's attempt to develop a relationship in this class will be successful in the case of inequality (1a), and it may be unsuccessful in the case of inequality (1b).

An entrepreneur's initial market-based power at the very beginning of a project, when there is just an idea of a project, is denoted as MP_{ent0}. As previously suggested in the subsection "market-based power", the entrepreneur's initial market-based power may be increased by investing in the development of new relationships identified in the relationship web (Figure 1). Investing into relationships with a qualified management team, for example, will likely result in increased market-based power that may be sufficient to develop relationships with a licensor or investor. Investing into the development of any of these two relationships would, in turn, result in further increase of the entrepreneur's market-based power relative to other stakeholders. An entrepreneur's market-based power is thus proportional to the total investment he or she has made in relationship web relationships – assuming low slack or inefficiency in the relationship investments. Consistent with Williamson's (1985) concept of transaction specific investments, aggregate relationship investment (*ARI*) is defined as the total investment of time, money, and other resources in relationship web relationships at a given point in time. Since different relationships require different investments, the order in which relationships are developed affects ARI at any given point in time.

In addition to investing in relationships, an entrepreneur's market-based power can also be increased by increasing the attractiveness of an exchange offer. For example, an entrepreneur might: increase the share of the stock available to an investor for the same amount of funding; lower the price of a product to a lead customer; or offer more favorable terms to a supplier. In all these situations, the value of the respective transaction to the entrepreneur is reduced. Therefore, an entrepreneur's market-based power may be increased in transactions with another party by reducing the value retained by the entrepreneurial venture, or increasing the value retained by the other party. For this reason, it is assumed here that an entrepreneur's market-based power is inversely proportional to the transaction value *TV*.

Transaction value is defined using the concept of business potential. Business potential (BP) is the present value of potential future cash inflows to the business that are associated with the commercialized technology. Transaction value is the share of the business potential that remains with the creating entity's business after a new relationship is developed. For example, the value of the transaction with the management team is:

$$TV = BP - \alpha \qquad (2)$$

Where α represents the combined share of earnings on the company's stock by the management team members and the combined present value of their future earnings as managers or advisors. The value of a transaction with the 'licensor' is described by the same formula (2) with α including the licensor's stock share earnings, license fee, and the royalties.

To summarize, market-based power can be derived from two major sources: investing in new relationships of the relationship web and reducing transaction value to the entrepreneur. Market-based power is proportional to the aggregate relationship investment and inversely proportional to the transaction value. Mathematically, two above described functional dependencies may be expressed as:

$$MP_{ent} = MP_{ent0} \left(1 + \frac{ARI}{TV} \right) \qquad (3)$$

It is seen from (3) that market-based power increases if *TV* is reduced. Let us assume, for example, that a regular market price for the first round financing at a given market place is between 40 and 50 percent shares of the stock. Then according to (2) and (3), offering 70 percent would reduce the transaction value (increase the cost of establishing this relationship) and increase the market-based power if other conditions are equal. In the limit of $ARI \rightarrow 0$, market-based power tends to its initial value when there is only an entrepreneur and idea of the project. The same result is achieved if transaction value tends to infinity ($TV \rightarrow \infty$).

The condition (1a) for an entity to have enough market-based power to develop a new relationship can then be rewritten, accounting for (3), as:

$$MP_i = \mu_i \left(1 + \frac{ARI_i}{TV_i} \right) \geq 1 \qquad (4)$$

Here MP_i is the entrepreneur's market-based power relative to the market-based power of the partner in i-th relationship, $i = 1, 2, ..., N$ is a number prescribed to a relationship class, N is the total number of all classes, and μ_i is the market-based power's initial value when there is only the entrepreneur and an idea of a project. For example, the initial market-based power relative to the 'investor' is $\mu_9 = MP_{ent0} / MP_{inv0}$.

The total number of relationships to manage N depends on the relationship web for a particular project; $N = 9$ for the generic relationship web depicted in Figure 1. Using the nomenclature of Figure 1, for example, $i = 9$ for a relationship with the 'investor.' The sequence in which relationships should be developed for a particular project may differ from the order suggested in Figure 1. According to the *ARI* definition given above,

$$ARI_i = ARI_{i-1} + RI_i \qquad (5)$$

for $i = 2, 3, ... N$, and $ARI_1 = RI_1$. Here RI_i is an investment into a given relationship, i accounting for the order in which relationships are developed while ARI_i is an investment in to the relationship i plus into all previously developed relationships of the relationship web.

Inequality (4) provides a key to solving the problem of identifying the order in which relationships should be developed. Transaction value in equation (4) is measured in dollars and evaluated from assumptions on sales revenues, before and after tax profits, costs of management, supply, etc. Relationship investments can be evaluated in terms of time, money, and other resources and then converted to dollar equivalents. Therefore, relationship investments and transaction values are calculated from the entrepreneur's personal data (memory, receipts, contact files, etc.) and data available in the business plan. An example of this calculation is provided subsequently.

The initial market-based powers μ_i with respect to potential partners in the i-th relationship can be evaluated from the data on previous successful projects in the same industry, local area, and under the same market conditions.

The data on ARI and TV for successful local technology start-ups is required to evaluate their initial market-based powers. This data may be gathered and analyzed by business consultants and local business development organizations. Iinitial market-based powers may then be evaluated using the equation:

$$\mu_i = MP_i \,/\, \left(1 + \frac{ARI_i}{TV_i} \right) \qquad (6)$$

This is obtained by applying a simple transformation of expression (4) for MP. ARI is estimated by assessing the money value of the time, effort, and resources, which were dedicated to establishing and maintaining exchange relations with a stakeholder of a local successful technology start-up. Depending on the assumed payback time, transaction values (TV) can be evaluated by estimating the business potential (present value) of a start-up (typically 5 to 7 years out) using cash flows and the market value of the business projected in its business plan - assuming that these figures are attainable and using a discount rate based on a minimum risk alternative such as a government issued security. Transaction value for a specific stakeholder can be calculated by taking the entire business potential and subtracting the projected net earnings or proceeds gained by that stakeholder as a result of the relationship. The net earnings or proceeds gained by the management team, for example, is the present value of cash outflows on their total remuneration, plus their share of retained earnings (if they are paid to them as dividends), plus the present value of their share of the company's market value over an assessment period. A similar calculation could be used to assess TV for 'advisors' or 'licensors'. Transaction values with the 'suppliers', 'distributors', and 'customers' who don't possess any company's shares, are estimated by subtracting from the business potential, the present values of cash outflows related to these stakeholders from the business potential. Cash outflow related to the suppliers is just a cost of supply, and cash outflow related to the distributors may be simply be a percentage of sales revenue generated by the distributors.

After ARI and TV are evaluated, μ_i can be calculated from (6) with all MP = 1. Indeed, as is previously mentioned, μ_i are evaluated from data on successful companies. This means all MP ≥ 1. If, in addition, the data are used on companies that achieved commercialization in the most efficient way, all MP should be equal to unity. The measures of initial market-based powers per one million dollar business potential ν_i are valuable because it is reasonable to assume that initial market-based powers for a particular project depend only on its business potential. Then initial market-based powers per one million dollar business potential don't depend on a particular project and are the same or very close to each other for all projects in a given industry, location, and at given market conditions.

This analysis could be applied to a number of previous related projects in an industry - perhaps by regional business development organizations - and the resulting, calculated expected values μ_i, could then be expressed per million dollar business potential, $\nu_i = \mu_i / BP$. This would allow entrepreneurs and start-up advisors to select a relevant set of comparison ν_i's, calculate the average, and multiply this value by business potential of a considered start-up to assess its initial market-based powers:

$$\mu_i = \nu_i * BP \quad (7)$$

The resulting μ_i for a particular project could be used to evaluate the project's market-based powers MP_i for different relationship sequences using equation (4).

It is known from economics that markets tend to 'clear' so that demand and supply are in approximate equilibrium (e.g. Pindyck and Rubinfeld 1998). Then, on the average, $MP_i \approx 1$, or the parties' average market-based powers are approximately equal. However, it is expected that most initial market-based powers will be less than unity ($\mu_i < 1$ for all $i = 1, 2, \dots, N$) because normally an entrepreneurial 'idea' is not valuable enough to be a sellable "work" until sufficient investments are made and relationships developed to create a viable venture and achieve $MP_i \geq 1$ for subsequent relationships. Before then the transaction value is less than the relationship investments.

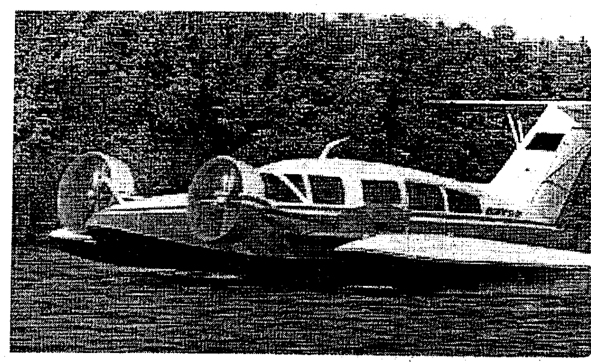
To decide on the order in which relationships should be developed, it is required, ideally, to conduct calculations on all possible transaction orders and to evaluate MP_i for all relationships in all these trials. Acceptable (or effective) sequences are those where inequality (4) results in $MP_i \geq 1$ for all $i = 1, 2, \dots, N$. Some sequences, however, are more efficient than others with respect to total aggregate relationship investment and the creating entity's share of the business potential. While evaluation of all sequence permutations of 9 classes of relationships (9!=362,880 combinations) could be achieved with computer programming, an approximate solution is achievable by selecting a few intuitively appealing permutations and evaluating these permutations by varying key parameters in a spreadsheet. While managers and entrepreneurs currently make relationship sequence decisions intuitively based on prior experience and heuristics, even the approximate solution proposed here helps to make the decision less art and more science with a process that is more explicit, precise, and, therefore, less risky.

MANAGERIAL IMPLICATIONS: Application to GEM Commercialization

Alexiev and GEM Technology

Aerodynamic ground effect results from an increase in lift and decrease in drag for a plane flying close to a surface below. Ground-effect machine (GEM) is a high-speed amphibious vehicle (see Figure 3) that is especially designed to utilize the aerodynamic ground effect – operating as a boat (on water) or as an airplane flying just above the ground (water or land). Alexiev Transportation of Canada Ltd. (Alexiev) is a company especially incorporated under the Canada Business Corporations Act to commercialize the GEM technology. Alexiev has acquired a license from Alexiev Central Hydrofoil Design Bureau (a Russian research and production corporation) to manufacture and sell ground-effect machines and this license is exclusive in Canada, the United States, and Mexico. Two GEM vehicle models have been licensed to Alexiev. One is an 8-seat vehicle that operates either as a boat or flies about two feet off the ground (or water) in dynamic air cushion mode, at a cruising speed of 60 to 70 miles per hour (Figure 3). The second is a 2-seat model that can also fly like an airplane and in dynamic air cushion mode flies about 7 feet off the ground (or water) at a speed of 120 miles per hour. It is ideal for ecological, patrol, and search and rescue purposes because it can operate as a speedboat as well as an airplane.

FIGURE 3
ALEXIEV TRANSPORTATION 8-SEAT GEM VEHICLE



GEM technology has numerous advantages over possible substitutes. GEM vehicles are faster than boats, significantly lower in price and are less expensive to operate than helicopters or similar sized airplanes. They do not require a pilot's license or airport infrastructure and they can operate on and over all surfaces including ice and cracked ice. They are superior to hydrofoils and hovercraft in terms of speed, sea state capability and operational economy. They are also environmentally friendly because they don't disturb the water and don't create a wake. Their propellers are designed to be highly efficient and minimize noise. Uses of the ground-effect vehicle technology could include passenger, cargo, or mail transport, emergency, patrol, ecological, and search and rescue services, tourism and recreation services, and high-speed water taxi service. One industrial customer segment is resource companies working in areas with minimal road and airport infrastructure.

Alexiev Relationship Web

The previously discussed generic relationship web, illustrated in Figure 1, is applicable to Alexiev Transportation. Indeed, the project is very sophisticated from both business and technology perspectives and definitely requires a team of highly qualified managers and advisors. There are only three companies in the world possessing this technology, and it is impossible to develop it without large amounts of money and other resources. Therefore, developing a relationship with one of these three licensors is critical for any business project capitalizing on this technology. Furthermore, relationships with key suppliers of GEM's parts are critical because manufacturing the plane from 'scratch' (from raw materials) would involve enormous expenditure on manufacturing equipment and labor and would not be affordable for a start-up with expectations of $10 - 20 million in sales. Alexiev's two key suppliers are the licensor itself and a long-term ally of that licensor that is also a well-known Russian aerospace company. Alexiev has developed preliminary 'pilot' relationships with three potential customers from a major customer segment - air taxi companies. One of these potential customers in Alaska has offered to be an Alexiev agent-distributor for the Alaska area, which would allow Alexiev to sell efficiently and provide effective after sale support in northern markets. Alexiev is still looking for investors and has approached investment brokers to assist in this task. Thus, the only difference between the generic relationship web of Figure 1 and the Alexiev's relationship web is that the licensor is also acting on behalf of the management team in securing transaction relationships with another key supplier. While key relationships in Alexiev's relationship web have already been developed by employing an expensive and time consuming 'trial and error' method, the Stakeholder Sequence Model described previously can be used to identify an efficient relationship sequence for Alexiev.

Alexiev Efficient Stakeholder Sequence

Because Alexiev is positioned in a new segment of the Aerospace industry, data sufficient to estimate initial market-based powers μ_i using equation (7) are not available. However, to illustrate the technique of applying equation (4) to determine an efficient sequence of relationship development, we assume that the initial market-based power μ_i = .999426, which is the value of μ_1 calculated for Alexiev's relationship with its management team using equation (6) and assuming that $MP_i = 1$ and inputting estimates for TV and ARI provided by Alexiev's founder.

Market-based power is estimated here from equation (4) for different sequences in which relationships may be developed by varying parameters in an MS Excel spreadsheet. An important assumption is made that transaction values don't depend on the sequence in which relationships are developed. Indeed, executive salaries, licensor royalties, etc. are set normally by industry standards and do not vary significantly with the order in which relationships are managed. Another important assumption is that both investments in particular relationships and the total value of investments into all relationships also don't depend on the sequence in which relationships are developed. These assumptions could be dropped with more sophisticated analytical tools. The most efficient sequence, given initial market-based powers, transaction values, and the values of particular relationship investments, is then identified as one having the maximum total market-based power – being able to secure the key stakeholder relationships while minimizing either the attractiveness of the offers across the set of relationships or investments in developing these relationships. Total market-based power, the market-based power represented by a set of transaction relationships, is conceptualized as a vector whose components are the particular market-based powers for relationships with different stakeholders. In-so-f far as all components of this vector must be greater than 1, total market-based power is measured by taking the square root of the sum of the squared deviations of each component of the vector from unity:

$$MPT = \left(\sum_i (MP_i - 1)^2\right)^{1/2} \quad (8)$$

This measure of central tendency is consistent with the approach prescribed by Smith and Barclay (1997), which captures in the measure both the magnitude and variance of the vector components. Therefore, the efficient sequence of relationship web relationships is the one that maximizes market-based power of the entire set (MPT) as calculated from equation (8).

MPT calculations for six sequences in which relationship web relationships could be developed are shown in Table 1. Of the sequences considered, MPT is maximized for sequence F given assumptions about transaction values and initial market-based powers – suggesting that a relatively efficient order in which key stakeholder relationships could have been developed for Alexiev is the following: licensor, management, advisors, customers, investment brokers, investors, governments, distributors, and suppliers. Sequence A is also quite efficient and might be considered a reasonable alternative should practicalities (such as availability of stakeholders) make sequence F difficult to implement. However, we have only identified the efficient sequence (F) that would enable the maximum reduction of RI or increase in TV from their given values, to those values resulting in MP=1. We have not actually assessed the values of RI and TV that would be achieved by Alexiev for any of the sequences from A to F represented in Table 1. Hence, we do not know the substantive difference between the most efficient sequence F, and other near efficient sequences such as A. The actual achievable values of RI and TV for these sequences could be assessed using a method of successive approximations. The application of this methodology, however, is beyond the scope of this article.

CONCLUSION

Drawing on stakeholder theory, network theory and the transaction cognition theory of entrepreneurship (Mitchell 2001a), a stakeholder sequence model was developed that helps entrepreneurs, project managers, and start-up advisors identify an efficient sequence in which classes of key stakeholder relationships should be developed. This model, like any other, is a representation of a more complex reality,

TABLE 1
RELATIONSHIP WEB SEQUENCE COMPARISONS

Sequence	A		B		C		D		E		F	
Relationship	#	ARI	#	ARI	#	AIR	#	ARI	#	ARI	#	ARI
	1	18.5	1	18.5	1	18.5	3	24.5	8	27.5	3	24.5
	2	19.5	2	19.5	2	19.5	6	29	9	48.5	1	43
	3	44	8	47	3	44	7	35.5	1	66.5	2	44
	4	44.5	9	67.5	4	44.5	1	54	2	67.5	7	50.5
	5	98.5	3	92	8	72	2	55	6	72	8	78
	6	103	4	92.5	9	92.5	8	82.5	7	78.5	9	98.5
	7	109.5	6	97	5	146.5	9	103	5	132.5	5	152.5
	8	137	7	103.5	6	151	5	157	3	157	6	157
	9	157.5	5	157.5	7	157.5	4	157.5	4	157.5	4	157.5
MPT	0.008332		0.006852		0.007897		0.007675		0.008118		0.008472	

Note: Total market-based power (MPT) estimates are derived from equation (4), where the initial market-based powers for a given project are estimated from initial market-based powers obtained from equation (6) and historic data of successful related projects, under the assumption that for these historic successful projects all MP=1. The difference in MPT for the GEM project comes mainly from different Aggregate Relationship Investment (ARI), the values of which are given (in thousand dollars) in the table above.

aiding the communication and understanding of this reality. Simplifying assumptions and limitations need to be recognized, however, in order to evaluate the utility of the model.

The most fundamental assumption in this theory is that the dependencies between variables in equation (4) are linear. This assumption is supported, however, by knowledge that any continuous (differentiable) function may be expanded into a Taylor series within a small vicinity of any point, and that all non-linear terms of this expansion are much smaller than the preceding linear terms (e.g., Borowski and Borwein 1991). In other words, there is always a range , in which any continuous function is linear, and the developed model works.

In the application of the model to the Alexiev Ground Effect Machine (GEM) start-up, it was assumed that transaction value does not depend on the sequence in which relationships are developed. This assumption likely holds in developed markets with established prices. However, in most technology-intensive start-up contexts, transaction values do change. For example, developing a relationship with an investor prior to other relationships may enable an entrepreneur to achieve greater transaction values with the licensor, the managers, etc., or the same values may be achieved with lower relationship investments. This limitation could be overcome with more sophisticated analytic tools.

Finally, it was assumed that all parties to the relationships are equally legitimate. This means, in essence, that all stakeholders are assessed as either legitimate or not, and that illegitimate stakeholders are discarded. This is a significant simplification because there may be many degrees of legitimacy in the real world. However, it makes the effects of power on the choice of the efficient sequence more visible. This assumption could be relaxed in future research that models the effects of both power and legitimacy.

Even with these limitations, the developed model makes a number of contributions. From an academic perspective, we have extended the domain of stakeholder theory to include not only the issue of which stakeholders' demands for attention should be answered but also the issues of which relationships should be sought and in what order they should be developed. The stakeholder sequence model developed in this paper begins to address this latter issue by introducing and applying the concept of market-based power.

From a practical perspective using the Alexiev GEM vehicle example, we have demonstrated using the Alexiev GEM vehicle example, how data in a detailed business plan, supplemented by industry comparisons provided by business development organizations, can be used to identify efficient stakeholder development sequences. The stakeholder sequence model helps improve the technology commercialization process by showing entrepreneurs, project managers, and their advisors which stakeholder relationships should be developed at what stage of project development.

For business development organizations, we have shown the kind of data that could be collected and analyzed using the stakeholder sequence model. Having this data available would help improve the technology commercialization process, as entrepreneurs and project managers would have a more efficient strategy for stakeholder development. Greater efficiency in stakeholder development may encourage regional economic development as slack or waste is minimized.

Future extension of the stakeholder sequence model is needed to address the micro level issue of which particular stakeholder in a stakeholder class should be the focus of attention for a technology intensive start-up or project. This might also be accomplished using equation (4) by examining differences in the relative market-based power of alternative stakeholders, the relative investment required to develop those relationships, and the projected future value to the organization of transactions with each stakeholder. Integration of the stakeholder theory concepts of urgency and legitimacy would also be fruitful.

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