Incorporating Intellectual Property Issues into a Business Simulation©

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ABSTRACT

This paper presents a new simulation based upon a game design system developed by Teach (1985, 1986, & 1990). The creation and management of intellectual property (IP) plays a central role in this simulation. Firms research the potential of new products and then protect their newly discovered IP through the use of either patents or trade secrets. The firms then decide whether to (1) manufacture and sell this new product, (2) license the IP to a competitor and receive a front-end fee plus a royalty, or (3) sell the rights to the IP to a competitor. The selling or licensing of IP rights requires one-on-one negations between firms. The measure of success in the simulation is the profit maximization of the firm.

BACKGROUND

Over the years, a variety of authors discovered a set of methodologies, which include a important and often used variables that are used by actual firms into business simulations. Prey and Methè's classic article (1991), regarding simulation of the R&D investments benefits was a major inspiration for this business game's design. They noted that technology innovation was a major factor in competition and a key to market leadership. These authors stressed the need to develop a business policy simulation and provided an illustrative game. However, Pray and Methè's model uses a single market place and is not designed to account for new products for new markets. This paper does not deal with R&D investments as such, but emphasizes new products / inventions and provides protection for the firm's rights to the resulting intellectual property.

Hugh Cannon (1993) described a methodology to incorporate creative advertising strategy into business simulations. Cannon and Schwaiger (2004) reported a way to incorporate corporate reputation into a business simulation. Cannon, Cannon and Schwaiger (2005) developed a model that included customer lifetime value. Continuing their efforts in incorporation of new dimensions into business games, Cannon, Cannon and Schwaiger (2006) also developed a simulation that incorporated strategic product-mix decisions. And in 2011, the team of Bernard, and Cannon explored a way to include motivation in business simulations. However, no business game yet discovered by the authors has been designed to include the value of intellectual property.

The first game to acknowledge intellectual property (IP) rights, INTOP (THE INTERNATIONAL OPERATIONS SIMULATION) was developed in the 1960s. This game allowed "patents to be licensed globally or nationally, selectively or globally with provision as to the maintenance of minimum prices" (Torelli et al., 1967, page 289). Since then, intellectual property rights have only played minor roles in simulations. Wolfe (n.d.) produced a simulation called the GLOBAL BUSINESS GAME, which contained a feature described as "a firm obtains a patent after investing in a R&D budget for a number of quarters. The patent results in a distinctive feature that is easily recognized by the consumer. Firms can sell their patent(s) to others in the industry for prices negotiated between the parties. Other firms in the industry can try to purchase any patents available as soon as they are announced in the game's industry report." The most recent attempt to incorporate IP rights in a simulation is BACK BAY BATTERY (Christensen and Shih, 2008 revised 2009) from the Harvard Business School. This single-player, on-line simulation encompasses the issues of balancing a portfolio of investment strategies as well as managing R&D investment tradeoffs.

Intellectual property is extremely valuable to firms. Rivette and Kline (2000) suggested, "…the burgeoning knowledge economy has given rise to a new type of CEO and a new type of business competition--one in which intellectual assets, not physical ones, have become the principal sources of shareholder wealth and competitive advantage. And therein lies one of the next great corporate challenges: figuring out how to unlock the hidden power of patents." (Quote from page 54)

Kevin King, founding partner of Valuation Consulting commented (2003), "Intellectual capital is recognized as the most important asset of many of the world's largest and most powerful companies; it is the foundation for the market dominance and continuing profitability of leading corporations. It is often the key objective in mergers and acquisitions…" In addition, he added, "Intellectual property rights (IP rights) are not inherently valuable. Their value is the strategic advantage gained by excluding others from using the intellectual property."

Richards Patent Law newsletter published on the web in 2012 stated "The most valuable IP rights are those that provide a competitive advantage over your competitors and build equity in your brand. Whether your products provide unique functionality, improved efficiency or desirable aesthetics, the marketable value is in having your brand recognized as the exclusive source of these offerings."

Summers (2006) wrote about technology landscapes, a highly sophisticated methodology designed to study the new innovation discovery process that can also be used to develop simulations. In technology landscapes, a product is described as a vector of many attributes. The model used for the simulation described within this paper uses a vector of only a very small number of attributes. The goal here is not to represent the totality of reality, but rather just enough reality to convey learning about the management of intellectual properties commensurate with the amount of effort required in a university classroom or training program.

THE METHODOLOGY

The methodology utilized in the simulation presented in this paper is *the gravity flow model*. Gold and Pray (1997, page 132) explained Teach's model as follows: "… Teach (1985) developed a demand model allowing for heterogeneous consumer preferences and products with multiple market segments. Within each market segment Teach created a set of "ideal" product attribute mixes. A firm gains demand within any market segment by developing a product with a mix of attributes that is closer to one of the consumer's "ideal" preferences, but may lose some demand by moving further away from the ideal attribute mix of other consumers. The demand is also affected by marketing variables such as: price, advertising, promotion, and R&D." The primary gravity flow model used in the IP simulation can be shown as:

$A_{ij} = f((Mass_i \bullet Mass_{ij}^{k}) / (Distance_{ij})^{L})$

Where A_{ij} is the strength of the attraction between the $market_i$ and the $product_j$
$Mass_i$ is the market potential of $market_i$,
$Mass_{ij}$ is a function of the marketing efforts directed to $product_j$ in $market_i$,
k, usually 1, but values greater than 1 makes the elasticity with respect to marketing variables more elastic and values less than 1 makes the marketing variables less elastic.
$Distance_{ij}$ is the Cartesian distance between $market_i$ and $product_j$

And L is a parameter usually 2, but may vary as greater value of L make Aij have greater elasticity with respect to the distance between the ideal point the existing $product_j$ coordinate position.

While playing the simulation presented in this paper, the participants are expected to learn that intellectual property (IP) is an asset for developing firms. IP could be developed into a marketable product and/or could be licensed to other firms with price plus royalties agreements or could be sold outright to another firm. This simulation should also develop negotiating skills that are needed when firms license or purchase IP from each other.

This simulation is designed to be played successfully with as few as 4 and as many as 15 teams (firms). Each round is equivalent to a year and the simulation should be played for 8 to 12 rounds, depending upon the time available for play. The simulation begins with each firm selling two already developed products in an established market. These two products are beginning to approach the end of their product lifecycles. Thus, the firm must find one or more new products before the demand for the existing product expires in the 3rd and 4th simulated years.

The initial introduction of the simulation will require a typical class period of between 50 to 90 minutes, with the participants making their first set of decisions in class. After the introduction, successive rounds should take 20 to 30 minutes each. After the first set of decisions (round 1), the decision-making can be made outside of class time and the results of the rounds' decisions should be available for the class. That way the participants could clarify any questions regarding the consequences of the decisions on the outcomes. The purchase, sale or the licensing of patents as well as the required detailed analysis of the outcomes can be accomplished outside of the class time.

THE INTELLECTUAL PROPERTY SIMULATION

This intellectual property simulation uses a four-dimensional (45 by 45 by 45 by 2, integers only) space consisting of three unique product attributes (X, Y, and Z) and one dummy dimension (D). The dummy dimension (D = 1) prevents a product and a customer segment (D = 0) from occupying the same location within a three-dimensional attribute space. To do so would cause a fatal division-by-zero error within the mathematics of the simulation. While it would be possible to add more attributes by adding more dimensions, this would add complexity without a corresponding increase in learning. For the purposes of generality, the "practitioner world" definition of the three product attributes will not be specified in this description.

During the initialization of the simulation, a set of customer segments is generated using a uniform random process in the customer segment space existing within X = 10 to 35, Y = 10 to 35, Z = 10 to 35 and D = 0. The number of customer segments may be adjusted as the simulation administrator desires; this description will use 3 although the recommended number is in the range of 4 to 20. At the same time, unit market potential of each customer segment is randomly generated as a uniform random process ranging from 1 to 20 which is then multiplied by 10.000 more or less. Thus, each time the simulation is played, an entirely new problem exists for the learners and information about specific products from previous runs is totally useless. As it could be disheartening for players if they never find the customer segments, it is suggested that some general information about the location of these, such as the number of segments in a particular range be provided to the players.

The product space exists within X = 10 to 35, Y = 10 to 35, Z = 10 to 35 and D = 1. Thus there are 25^3 or 16,625 possible unique products in this simulation configuration. The product development cost for each cell within this space is constant. This results in deterministic development costs for the firms. Although actual development costs are stochastic in nature, this particular loss of realism is done for the enhancement of learning as it makes the profit objective somewhat controllable by the learners and not just a matter of luck.

If the distance between a customer segment's ideal product and a firm's researched product is greater than 10 for any individual attribute, the customer segment will not be interested in purchasing that product. While this restriction on distance is an artificial barrier, it simplifies the burden of analysis.

This simulation assumes that the product development times are all equal to one year; this is once again a simplification to enhance the learning objective.

At the end of each round, a status report is provided to all players. The report denotes each product's specifications, each product's unit sales and the total unit market potential within each known market. For trade secret products there are no reported specifications. A firm is allowed to conduct marketing research for up to 10 products per round at a cost of $10,000 per product. However, a firm may hold no more than a total of 10 patents. A firm may decrease it patents by selling or abandoning one or more of its patents. If a firm license's a patented product, it still counts as an owned patent.

The simulation will report to each researching firm the maximum market potential for each of these researched products. The simulation will only consider competitive products currently in marketplaces and ignore any potential products not yet developed or any potential marketplace with no products. The firm then decides which of these potential products to patent at a cost of $5,000 each. It costs an additional $50,000 to develop a product ready fur the marketplace. There is a minimum one-year lag between patenting a product and its market entry.

There are only four methods to increase a firm's marketplace success. In the first strategy, a firm may increase/decrease its promotional budget, increase/decrease its price or do both. The second strategy requires the firm to introduce a new product to its existing marketplace. While this method may be profitable, the firm will incur product cannibalization. The third strategy requires the firm to introduce a new product into a new marketplace. This strategy may be the most risky, but it may also be the most profitable. Both strategies two and three require exploring the wants and needs of potential customers. The fourth strategy is putting an existing product into new marketplace. This simulation is designed in a way that does not allow this fourth strategy to be used.

Firms wishing to use the second or third strategy need to develop clear search techniques. One approach is to conduct a broad patterned search. When a new market is discovered, the firm conducts a concentrated search. However, this requires more time. An alternative search pattern is to focus on relatively small area. This is a more risky strategy, but if it finds a new marketplace, it gains a year in developing this market.

Decisions necessary for simulation include 1) changes in manufacturing capacity; 2) the number of units to produce for each product being sold (raw materials are automatically ordered); 3) the price of each active product; 4) the promotional budget for each active product (teams my promote a product in development, but not yet released); 5) the number of potential new products in which the firm wishes to conduct marketing research and the physical characteristics of each possible new products; 6) determine which of researched product configurations, completed in a prior period, to patent or hold as trade secrets; 7) determine which product configurations to abandon and which to hold for possible future development; 8) decide the strength of the protection for each newly patented product; 9) disposition of excess inventory; 10) determine which produces to offer for sale or license to competitors; 11) to decide whether or not to buy or license another firm's product; 12) to forecast sales in units for each product in the marketplace. In addition, firms may need to enter licensing or purchasing negations between rounds.

Once a firm has located a new product with significant potential, it must then decide how to protect this intellectual property. The firm may choose to never reveal the product's mix of attributes; this is called a trade secrete. Coca Cola, Inc. and KFC Corporation are good examples of firms that use trade secrets to protect their intellectual property. Instead, a firm may decide to obtain a patent. A patent reveals a product's three attributes.

There are three types of patents in this simulation, which vary in cost, depending on the level of protection. This is not a reflection of reality, but it makes the game more playable in that very closely related copycat products may be excluded. These three types of protection are: *narrow, mid-level and encompassing*. A *narrow* patent only protects the exact position of its product. An example would be cell A = 15, B = 20, C = 22. Thus, only 1^3 or 1 cell in the matrix is protected. A *mid-level* patent protection is similar to the single cell narrow patent except that it expands the protected area by one space on each side of the narrow patent's cell by one 1 space in all 3 dimensions. For example, this would be cells A = 14 to 16, B = 19 to 21, C = 21 to 23. Thus 3^3 or 27 cells in the matrix are protected. An *encompassing* patent expands the protected area by 2 spaces on each side of the patent's point. For example, this would protect cells A = 13 to 17, B = 18 to 22, C = 20 to 24. Thus 5^3 or 125 cells in the matrix are protected.

Competitive firms are free to research and produce any product as long as it does not impinge on another firm's patent. If a firm patents a product such that the cells protected include an attribute combination of another firm's trade secret product, the patent takes precedent and the trade secret product is removed from the market.

Although patent protection currently lasts 12 years in the USA, this time frame is too long for this simulation to be playable. Thus, in this simulation patent protection only lasts 6 years (rounds). Once a product has been patented or declared a trade secret, the following life cycle occurs:

- Round x: The product reaches 20% of the current sales potential.

- Round x + 1: The product reaches 50% of the current sales potential.
- Round x + 2 to 5:The product reaches full current sales potential.
- Round x + 6 onward: The product stays at full current sales potential; however if it has been patented, the protection will have expired and other firms may begin to produce its product configuration (generic). If this happens, the market is split equally among all firms producing the exact product configuration.

A firm may decide sell or license the patent, trade secret or developed product to a competitor at any point during the simulation. Negotiations in the selling and buying take place between any and all firms at any time during the course of the simulation. One firm may approach another firm either in public or privately. Of course, the simulation administrator must be kept apprised as to when these negotiations are to take place and the outcomes of the negotiations. It may be possible for a firm to follow an R&D strategy and never manufacture a product by researching and selling the rights to its discoveries to other firms in the simulations.

For each customer segment, there is a "ghost" customer similar to Teach's (1985) "customer shadow". This ghost is located "n units" of distance away from the customer segment's ideal point. The game's administrator may alter parameter "n". The location within the grid is not specified for the ghosts are always exactly "n" units of distance away. This feature allows the actual customer segments to purchase less of the product as the distance from the ideal point increases. The ghost soaks up the unsatisfied market potential and this value is reported back to the firms as unsold but potential sales. This provides some feedback about how to improve the prospect for better customer satisfaction. Note that the market potential is not affected by marketing decisions but rather is entirely calculated upon how well the product matches the consumer segments' ideal products.

SIMULATION OUTPUTS

The game produces a set of balance sheets and income statements for each firm in the game. It reports to each firm the results of its marketing research. In addition it reports to all firms 1) all patented product configurations and the dates they were patented; 2) the unit sales of each patented product; 3) the market potential for each market in which a product is being sold; 4) the unit sales of any trade secret products being sold, but it does not report either trade secrete product configurations nor the market potentials of the markets in which trade secrete products are sold.

ADAPTATIONS OF THE INTELLECTUAL PROPERTY SIMULATION

This simulation may be adapted into a more complex management simulation by incorporating additional aspects to produce a simulation with higher fidelity. The aspects include, but are not limited to more significant finance, accounting, marketing and manufacturing. Each attribute could have a specific cost and include volume discounts. In addition, any product could have a direct and indirect labor component, a manufacturing overhead component, and a corporate wide based overhead component. The manufacturing process could also have a learning curve applied to it. Marketing could have both a sales function with associated fixed and variable costs and a much more sophisticated promotional component. The accounting process could develop methods of establishing standard costs and also account for situations when the actual unit costs were either above standard or below standard. Detailed managerial accounting as well as financial accounting could be included. The finance part of the simulation could link the supply of existing capital supplemented by borrowing and/or the sale of bonds as well as the sale of shares of stock. The firms will need these funds to support the purchase of capital equipment for replacement of worn-out equipment.

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